PB82-139437

Napthalene: Pesticide Registration Standard

(U.S.) Environmental Protection Agency
Washington, DC

Sep 81

U.S. Department of Commerce
National Technical Information Service
NTIS

United States
Environmental Protection
Agency

Office of
Pesticides and Toxic Substances
Washington DC 20460

September 1981

Pesticides

EPA

Naphthalene

PB82-139437

Pesticide Registration Standard

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

NOTICE

THIS DOCUMENT HAS BEEN REPRODUCED FROM THE BEST COPY FURNISHED US BY THE SPONSORING AGENCY. ALTHOUGH IT IS RECOGNIZED THAT CERTAIN PORTIONS ARE ILLEGIBLE, IT IS BEING RELEASED IN THE INTEREST OF MAKING AVAILABLE AS MUCH INFORMATION AS POSSIBLE.

REPORT DOCUMENTATION PAGE

1. REPORT NO.

2.

3. Recipient's Accession No. PB82 139437

4. Title and Subtitle
Pesticide Registration Standard
Naphthalene

5. Report Date September 1981

6. 351001

7. Author(s) USEPA, Special Pesticide Review Division (SPRD) and Registration Division (RD)

8. Performing Organization Rept. No.

9. Performing Organization Name and Address
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

10. Project/Task/Work Unit No.

11. Contract(C) or Grant(G) No.
(C)
(G)

12. Sponsoring Organization Name and Address
Same as #9

13. Type of Report & Period Covered

14.

15. Supplementary Notes

16. Abstract (Limit: 200 words)

This document contains information regarding reregistration of pesticide products containing Naphthalene including how to register under a registration standard, regulatory position and rationale, and summaries of data requirements and data gaps. Also included is a bibliography containing citations of all studies reviewed by EPA in arriving at the positions and conclusions contained in the Standard.

17. Document Analysis a. Descriptors
Registration Standard
Naphthalene

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement

19. Security Class (This Report) Unclassified

20. Security Class (This Page)

21. No. of Pages 98

22. Price

(See ANSI-Z39.18)

See Instructions on Reverse

OPTIONAL FORM 272 (4-77)
(Formerly NTIS-35)
Department of Commerce

Naphthalene

REGISTRATION STANDARD
Office of Pesticides and Toxic Substances

Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460
1981

NAPHTHALENE

Acknowledgements

I. Special Pesticide Review Division (SPRD)

Stephanie Roan	Lead Project Manager
Benjamin Lemlich	Project Manager
Paul Parsons	Project Manager
Lynda Priddy	Project Manager

II. Technical Support Team

A. Hazard Evaluation Division (HED)

George Beusch	Chemist
John Jordan	Microbiologist
Charles Lewis	Agronomist
Arthur Schlosser	Environmental Chemist
Robert Storherr	Chemist
Ellen Sullivan	Pharmacologist
Allen Vaughan	Entomologist
Elizabeth Zucker	Wildlife Biologist

B. Benefits and Field Studies Division (BFSD)

Douglas Chambers	Vertebrate Biologist
Hoyt Jamerson	Entomologist
Russell Scarato	Economist
E. David Thomas	Supervisory Entomologist Section Head

C. Registration Division (RD)

Lachman Bhatia	Biologist
William Miller	Product Manager

III. Special Acknowledgement

A. Special Pesticide Review Division (SPRD)

Paul Lapsley	Branch Chief
Joan Warshawsky	Section Head
Barbara Moore	Secretary
Tonda Hicks	Clerk Typist

TABLE OF CONTENTS

Pages

I. How to Register Under a Registration Standard........... 1

- A. Organization of the Standard..................... 1
- B. Purpose of the Standard.......................... 1
- C. Requirements to Reregister Under the Standard.... 2
- D. "Product-Specific" Data and "Generic" Data....... 3
- E. Data Compensation Requirements Under FIFRA 3(c)(1)(D)................................ 4
- F. Obtaining Data to Fill Data Gaps; FIFRA 3(c)(2)(B)................................ 5
- G. Amendments to the Standard....................... 6

II. Regulatory Position.................................. 8

- A. Introduction..................................... 8
- B. Description of Chemical.......................... 8
- C. Regulatory Position.............................. 8
- D. Regulatory Rationale............................. 9
- E. Criteria for Registration Under the Standard..... 10
- F. Tolerance Reassessment........................... 14

III. Summary of Data Requirements and Data Gaps............ 15

- A. Table III.A Generic Data Requirements.......... 18
- B. Table III.B Product-Specific Data Requirements for Manufacturing-Use Products..... 26
- C. Table III.C Product-Specific Data Requirements for End-Use Products............... 30

IV. Product Chemistry.................................... 35

- A. Introduction..................................... 35
- B. Chemical Identity................................ 35
- C. Manufacturing Process............................ 35
- D. Product Analytical Methods and Data.............. 36
- E. Physical/Chemical Properties..................... 36
- F. Summary of Data Gaps............................. 38

V. Environmental Fate.................................... 39

- A. Use Summary...................................... 39
- B. Environmental Fate Profile....................... 39
- C. Exposure Profile................................. 40
- D. Summary of Data Gaps............................. 41

VI. Toxicology... 42

- A. Toxicology Profile: Technical Naphthalene........ 42
- B. Toxicology Profile: End-Use Naphthalene.......... 43
- C. Human Hazard Assessment.......................... 44
- D. Summary of Data Gaps............................. 44

VII. Residue Chemistry.. 45

VIII. Ecological Effects.. 46

A. Ecological Effects Profile........................ 46
B. Hazard Assessment.. 47
C. Summary of Data Gaps.. 47

IX. Efficacy.. 48

A. Efficacy Profile.. 48
B. Factors Influencing Efficacy........................ 48
C. Use Sites.. 48
D. Summary of Data Gaps.. 49

X. Confidential Annex.. 50

XI. Bibliography.. 51
Guide to Use of Bibliography

Section 1: Studies Reviewed and Judged Appropriate for the Standard
Section 2: Studies Reviewed and Judged Inappropriate for the Standard
Section 3: References

√

I. How to Register Under a Registration Standard

A. Organization of the Standard

This first chapter explains the purpose of a Registration Standard and summarizes the legal principles involved in registering or reregistering under a Standard. The second chapter sets forth the requirements that must be met to obtain or retain registration for products covered by this particular Registration Standard. In the remaining chapters the Agency reviews the available data by scientific discipline, discusses the Agency's concerns with the identified potential hazards, and logically develops the conditions and requirements that would reduce those hazards to acceptable levels.

B. Purpose of the Standard

Section 3 of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) provides that "no person in any State may distribute, sell, offer for sale, hold for sale, ship, deliver for shipment, or receive (and having so received) deliver or offer to deliver, to any person any pesticide which is not registered with the Administrator [of EPA]." To approve the registration of a pesticide, the Administrator must find, pursuant to Section 3(c)(5) that:

> "(A) its composition is such as to warrant the proposed claims for it;
> (B) its labeling and other material required to be submitted comply with the requirements of this Act;
> (C) it will perform its intended function without unreasonable adverse effects on the environment; and
> (D) when used in accordance with widespread and commonly recognized practice it will not generally cause unreasonable adverse effects on the environment."

In making these findings, the Agency reviews a wide range of data which registrants are required to submit, and assesses the risks and benefits associated with the use of the proposed pesticide. But the established approach to making these findings has been found to be defective on two counts:

First, EPA and its predecessor agency, the United States Department of Agriculture (USDA), routinely reviewed registration applications on a "product by product" basis, evaluating each product-specific application somewhat independently. In the review of products containing similar components, there was little opportunity for retrospective review of the full range of pertinent data available in Agency files and in the public literature. Thus the "product by product" approach was often inefficient and sometimes resulted in inconsistent or incomplete regulatory judgments.

Second, over the years, as a result of inevitable and continuing advances in scientific knowledge, methodology, and policy, the data base for many pesticides came to be considered inadequate by current scientific and regulatory standards. Given the long history of pesticide regulation in several agencies, it is even likely that materials may have been lost from the data files. When EPA issued new requirements for registration in 1975 (40 CFR 162) and proposed new guidelines for hazard testing in 1978 (43 FR 29686, July 10, 1978 and 43 FR 37336, August 22, 1978), many products that had already been registered for years were being sold and used without the same assurances of human and environmental safety as was being required for new products. Because of this inconsistency, Congress directed EPA to reregister all previously registered products, so as to bring their registrations and their data bases into compliance with current requirements. [See FIFRA Section 3(g)].

Facing the enormous job of re-reviewing and calling-in new data for the approximately 35,000 current registrations, and realizing the inefficiencies of the "product by product" approach, the Agency decided that a new, more effective method of review was needed.

A new review procedure has been developed. Under it, EPA publishes documents called Registration Standards, each of which discusses a particular pesticide active ingredient. Each Registration Standard summarizes all the data available to the Agency on a particular active ingredient and its current uses, and sets forth the Agency's comprehensive position on the conditions and requirements for registration of all existing and future products which contain that active ingredient. These conditions and requirements, all of which must be met to obtain or retain full registration or reregistration under Section 3(c)(5) of FIFRA, include the submission of needed scientific data which the Agency does not now have, compliance with standards of toxicity, composition, labeling, and packaging, and satisfaction of the data compensation provisions of FIFRA Section 3(c)(1)(D).

The Standard will also serve as a tool for product classification. As part of the registration of a pesticide product, EPA may classify each product for "general use" or "restricted use" [FIFRA Section 3(d)]. A pesticide is classified for "restricted use" when some special regulatory restriction is needed to ensure against unreasonable adverse effects to man or the environment. Many such risks of unreasonable adverse effects can be lessened if expressly-designed label precautions are strictly followed. Thus the special regulatory restriction for a "restricted use" pesticide is usually a requirement that it be applied only by, or under the supervision of, an applicator who has been certified by the State or Federal government as being competent to use pesticides safely, responsibly, and in accordance with label directions. A restricted-use pesticide can have other regulatory restrictions [40 CFR 162.11(c)(5)] instead of, or in addition to, the certified applicator requirement. These other regulatory restrictions may include such actions as seasonal or regional limitations on use, or a requirement for the monitoring of residue levels after use. A pesticide classified for "general use," or not classified at all, is available for use by any individual who is in compliance with State or local regulations. The Registration Standard review compares information about potential adverse effects of specific uses of the pesticide with risk criteria listed in 40 CFR 162.11(c), and thereby determines whether a product needs to be classified for "restricted use." If the Standard does classify a pesticide for "restricted use," this determination is stated in the second chapter.

C. Requirement to Reregister Under the Standard

FIFRA Section 3(g), as amended in 1978, directs EPA to reregister all currently registered products as expeditously as possible. Congress also agreed that reregistration should be accomplished by the use of Registration Standards.

Each registrant of a currently registered product to which this Standard applies, and who wishes to continue to sell or distribute his product in commerce, must apply for reregistration. His application must contain proposed labeling that complies with this Standard.

EPA will issue a notice of intent to cancel the registration of any currently registered product to which this Standard applies if the registrant fails to comply with the procedures for reregistration set forth in the Guidance Package which accompanies this Standard.

D. "Product-Specific" Data and "Generic" Data

In the course of developing this Standard, EPA has determined the types of data needed for evaluation of the properties and effects of products to which the Standard applies, in the disciplinary areas of Product Chemistry, Environmental Fate, Toxicology, Residue Chemistry, and Ecological Effects. These determinations are based primarily on the data Guidelines proposed in 1978 (43 FR 29696, July 10, 1978, and 43 FR 37336, August 22, 1978), as applied to the use patterns of the products to which this Standard applies. Where it appeared that data from a normally applicable Guidelines requirement was actually unnecessary to evaluate these products, the Standard indicates that the requirement has been waived. On the other hand, in some cases studies not required by the Guidelines may be needed because of the particular composition or use pattern of products the Standard covers; if so, the Standard explains the Agency's reasoning. Data guidelines have not yet been proposed for the Residue Chemistry discipline, but the requirements for such data have been in effect for some time and are, the Agency believes, relatively familiar to registrants. Data which we have found are needed to evaluate the registrability of some products covered by the Standard may not be needed for the evaluation of other products, depending upon the composition, formulation type, and intended uses of the product in question. The Standard states which data requirements apply to which product categories. (See the third chapter.)

The various kinds of data normally required for registration of a pesticide product can be divided into two basic groups:

1) data that are "product specific," i.e., data that relate only to the properties or effects of a product with a particular composition (or a group of products with closely similar composition); and

2) "generic" data that pertain to the properties or effects of a particular ingredient, and thus is relevant to an evaluation of the risks and benefits of all products containing that ingredient (or all such products having a certain use pattern), regardless of any such product's unique composition.

The Agency requires certain "product specific" data for each product to characterize the product's particular composition and physical/chemical properties (Product Chemistry), and to characterize the product's acute toxicity (which is a function of its total composition). The applicant for registration or reregistration of any product, whether it is a manufacturing-use or end-use product, and without regard to its intended use pattern, must submit or cite enough of this kind of data to allow EPA to evaluate the product. For such purposes, "product specific" data on any product other than the applicant's is irrelevant, unless the other product is closely similar in composition to the applicant's. (Where it has been found practicable to group similar products for purposes of evaluating, with a single set of tests, all products in the group, the Standard so indicates.) "Product specific" data on the efficacy of particular end-use products is also required where the exact formulation may affect efficacy and where failure of efficacy could cause public health problems.

All other data needed to evaluate pesticide products concerns the properties or effects of a particular ingredient of products (normally a pesticidally active ingredient, but in some cases a pesticidally inactive, or "inert", ingredient). Some data in this "generic" category are required to evaluate the properties and effects of all products containing that ingredient [e.g., the acute LD-50 of the active ingredient in its technical or purer grade; see proposed 40 CFR 163.81-1(a), 43 FR 37355].

Other "generic" data are required to evaluate all products which both contain a particular ingredient and are intended for certain uses (see, e.g., proposed 40 CFR 163.82-1, 43 FR 37363, which requires subchronic oral testing of the active ingredient with respect to certain use patterns only). Where a particular data requirement is use-pattern dependent, it will apply to each end-use product which is to be labeled for that use pattern (except where such end-use product is formulated from a registered manufacturing-use product permitting such formulations) and to each manufacturing-use product with labeling that allows it to be used to make end-use products with that use pattern. Thus, for example, a subchronic oral dosing study is needed to evaluate the safety of any manufacturing-use product that legally could be used to make an end-use, food-crop pesticide. But if an end-use product's label specified it was for use only in ways that involved no food/feed exposure and no repeated human exposure, the subchronic oral dosing study would not be required to evaluate the product's safety; and if a manufacturing-use product's label states that the product is for use only in making end-use products not involving food/feed use or repeated human exposure, that subchronic oral study would not be relevant to the evaluation of the manufacturing-use product either.

If a registrant of a currently registered manufacturing-use or end-use product wishes to avoid the costs of data compensation [under FIFRA Section 3(c)(1)(D)] or data generation [under Section 3(c)(2)(B)] for "generic" data that is required only with respect to some use patterns, he may elect to delete those use patterns from his labeling at the time he reregisters his product. An applicant for registration of a new product under this Standard may similarly request approval for only certain use patterns.

E. Data Compensation Requirements under FIFRA 3(c)(1)(D)

Under FIFRA Section 3(c)(1)(D), an applicant for registration, reregistration, or amended registration must offer to pay compensation for certain existing data the Agency has used in developing the Registration Standard. The data for which compensation must be offered are all data which are described by all of the following criteria:

1) the data were first submitted to EPA (or to its predecessor agencies, USDA or FDA), on or after January 1, 1970;

2) the data were submitted to EPA (or USDA or FDA) by some other applicant or registrant in support of an application for an experimental use permit, an amendment adding a new use to a registration, or for reregistration, or to support or maintain an existing registration;

3) the data are relevant to the Agency's decision to register or reregister the applicant's product under the Registration Standard, taking into account the applicant's product's composition and intended use pattern(s);

4) the data are determined by EPA to be valid and usable in reaching regulatory conclusions; and

5) the data are not those for which the applicant has been exempted by FIFRA Section 3(c)(2)(D) from the duty to offer to pay compensation. (This exemption applies to the "generic" data concerning the safety of an active ingredient of the applicant's product, not to "product specific" data. The exemption is available only to applicants whose product is labeled for end-uses for which the active ingredient in question is present in the applicant's product because of his use of another registered product containing that active ingredient which he purchases from another producer).

An applicant for reregistration of an already registered product under this Standard, or for registration of a new product under this Standard, accordingly must determine which of the data used by EPA in developing the Standard must be the subject of an offer to pay compensation, and must submit with his application the appropriate statements evidencing his compliance with FIFRA Section 3(c)(1)(D).

An applicant would never be required to offer to pay for "product specific" data submitted by another firm. In many, if not in most cases, data which are specific to another firm's product will not suffice to allow EPA to evaluate the applicant's product; that is, will not be useful to the Agency in determining whether the applicant's product is registrable. There may be cases, however, where because of close similarities between the composition of two or more products, another firm's data may suffice to allow EPA to evaluate some or all of the "product specific" aspects of the applicant's product. In such a case, the applicant may choose to cite that data instead of submitting data from tests on his own product, and if he chooses that option, he would have to comply with the Section 3(C)(1)(D) requirements with respect to each item of "generic" data that relates to his product's intended uses.

Each applicant for registration or reregistration of a manufacturing-use product, and each applicant for registration or reregistration of an end-use product, who is not exempted by FIFRA Section 3(c)(2)(D), must comply with the Section 3(c)(1)(D) requirements with respect to each item of "generic" data that relates to his product's intended uses.

A detailed description of the procedures an applicant must follow in applying for reregistration (or new registration) under this Standard is found in the Guidance Package for this Standard.

F. Obtaining Data to Fill "Data Gaps"; FIFRA 3(c)(2)(B)

Some of the kinds of data EPA needs for its evaluation of the properties and effects of products to which this Standard applies have never been submitted to the Agency (or, if submitted, have been found to have deficiencies rendering them inadequate for making registration decisions) and have not been located in the published literature search that EPA conducted as part of preparing this Standard. Such instances of missing but required data are referred to in the Standard as "data gaps."

FIFRA Section 3(c)(2)(B), added to FIFRA by the Congress in 1978, authorizes EPA to require registrants to whom a data requirement applies to generate (or otherwise produce) data to fill such "gaps" and submit those data to EPA. EPA must allow a reasonably sufficient period for this to be accomplished. If a registrant fails to take appropriate and timely steps to fill the data gaps identified by a Section 3(c)(2)(B) order, his product's registration may be suspended until the data are submitted. A mechanism is provided whereby two or more registrants may agree to share in the costs of producing data for which they are both responsible.

The Standard lists, in the third chapter, the "generic" data gaps and notes the classes of products to which these data gaps pertain. The Standard also points out that to be registrable under the Standard, a product must be supported by certain required "product specific" data. In some cases, the Agency may possess sufficient "product specific" data on one currently registered product, but may lack such data on another. Only those Standards which apply to a very small number of currently registered products will attempt to state definitively the "product specific" data gaps on a "product-by-product" basis. (Although the Standard will in some cases note which data that EPA does possess would suffice to satisfy certain "product specific" data requirements for a category of products with closely similar composition characteristics.)

As part of the process of reregistering currently registered products, EPA will issue Section 3(c)(2)(B) directives requiring the registrants to take appropriate steps to fill all identified data gaps -- whether the data in question are "product specific" or "generic" -- in accordance with a schedule.

Persons who wish to obtain registrations for new products under this Standard will be required to submit (or cite) sufficient "product specific" data before their applications are approved. Upon registration, they will be required under Section 3(c)(2)(B) to take appropriate steps to submit data needed to fill "generic" data gaps. (We expect they will respond to this requirement by entering into cost-sharing agreements with other registrants who previously have been told they must furnish the data.) The Guidance Package for this Standard details the steps that must be taken by registrants to comply with Section 3(c)(2)(B).

In addition, FIFRA Section 6(a)(2) requires the registrant to submit factual information raising concerns of possible unreasonable adverse effects of a pesticide. The registrant should notify the Agency of interim results of studies in progess if those results show possible adverse effects.

G. Amendments to the Standard

Applications for registration which propose uses or formulations that are not presently covered by the Standard, or which present product compositions, product chemistry data, hazard data, toxicity levels, or labeling that do not meet the requirements of the Standard, will automatically be considered by the Agency to be requests for amendments to the Standard. In response to such applications, the Agency may request additional data to support the proposed amendment to the Standard, or may deny the application for registration on the grounds that the proposed product would cause unreasonable adverse effects to the environment. In the former case, when additional data have been satisfactorily supplied, and providing that the data do not indicate the potential for unreasonable adverse effects, the Agency will then amend the Standard to cover the new registration.

Each Registration Standard is based upon all data and information available to the Agency's reviewers on a particular date prior to the publication date. This "cut-off" date is stated at the beginning of the second chapter. Any subsequent data submissions and any approved amendments will be incorporated into the Registration Standard by means of addenda, which are available for inspection at EPA in Washington, D.C., or copies of which may be requested from the Agency. When all the present "data gaps" have been filled and the submitted data have been reviewed, the Agency will revise the Registration Standard. Thereafter, when the Agency determines that the internally maintained addenda have significantly altered the conditions for registration under the Standard, the document will be updated and reissued for publication.

While the Registration Standard discusses only the uses and hazards of products containing the designated active ingredient(s), the Agency is also concerned with the potential hazards of some inert ingredients and impurities. Independent of the development of any one Standard, the Agency has initiated the evaluation of some inert pesticide ingredients. Where the Agency has identified inert ingredients of concern in a specific product to which the Standard applies, these ingredients will be pointed out in the Guidance Package.

II. Regulatory Position

A. Introduction

This chapter presents the Agency's regulatory position and rationale based on an evaluation of all registered products containing naphthalene as the sole active ingredient with the same use patterns described in this Standard. After briefly describing the chemical, this chapter presents the regulatory position and rationale, the criteria by which applications for registration of naphthalene products will be approved and the labeling considerations. A summary of the data requirements is contained in Chapter III. Discussions of the data upon which this regulatory position is based are presented in each of the disciplinary chapters, Chapters IV through IX.

B. Description of Chemical

Naphthalene is a crystalline solid which is packaged as balls, flakes or pellets. Because naphthalene is used to repel certain public health pests (bats), proof of its efficacy is a registration requirement (44 FR 27932: May 11, 1979), and is discussed in Chapter IX of this standard.

The accepted chemical name for this compound is naphthalene. The Chemical Abstracts Registry (CAS) number 91-20-3 and the EPA Shaughnessy number is 055801. The chemical formula is $C_{10}H_8$.

C. Regulatory Position

Naphthalene, as described in this Standard, may be registered for sale, distribution, reformulation and use in the United States. The Agency has considered the limited amount of scientific data obtained from the open literature as of June 1981, and the data submitted to the Agency by the registrants through the time of publication of this Standard. Based on review of these limited data, the Agency finds that none of the risk criteria found in Section 162.11(a) of Title 40 of the U.S. Code of Federal Regulations (CFR) was met or exceeded for naphthalene and that naphthalene does not appear to cause unreasonable adverse effects when applied in accordance with proper label directions and precautions. Naphthalene products currently registered may be reregistered subject to the conditions imposed for data requirements. New products may be registered under this Standard and are subject to the same requirements. Revised label requirements will be addressed in the Guidance Package which accompanies this Standard and in Chapter II.E of this standard (see 40 CFR 162.10 for a detailed description of standard labeling requirements).

D. Regulatory Rationale

A review of the available data regarding the manufacturing-use and end-use products of naphthalene shows that much information that could be used to support registration and reregistration is not available. No data were available to assess possible acute or subchronic dermal and/or inhalation effects, primary eye and/or dermal irritation, primary dermal sensitization, teratogenic, reproductive, mutagenic, or oncogenic effects, of naphthalene, and no data were available to determine the ecological effects or the environmental fate of naphthalene.

The Agency has the prerogative to not only request information to satisfy the data Guidelines proposed in 1978 and 1980, but also to require additional testing under 3(c)(2)(B) of FIFRA). These additional tests may be requested by the Agency if it believes that particular concerns regarding the health or environmental effects of a pesticide must be evaluated. In some cases, this additional testing may be deferred pending the Agency's development of specific test protocols or the completion of other related tests (e.g., tiered testing).

It is the policy of the Agency not to request automatically guideline information simply because a particular guideline exists. Each element of the guideline is considered individually with regard to the pesticide's uses, exposure and risk. If the Agency concludes that specific elements of the data guidelines are required to prepare a comprehensive Registration Standard, the data will be requested.

Although the data base for naphthalene is incomplete, the Agency has concluded that it should continue registration for this product for the following reasons:

1) No significant adverse effects have been uncovered in the review of studies pertinent to naphthalene when used in accordance with current label instructions. These studies include some which meet guideline data requirements and some which, while failing to meet guideline requirements, provide a level of qualitative information. As a result of examining these studies, the Agency has concluded that there is no immediate cause for regulatory concern.

2) The Pesticide Incident Monitoring System's (PIMS) report #155 of February, 1979,reports 191 accidents involving naphthalene. One hundred and sixty-four of these incidents involved human exposure to naphthalene as a single active ingredient. Forty-nine percent of the accidents resulted from ingestion or suspected ingestion. In fewer than 1% of the cases, the exposure was reported to be via inhalation. In the remaining (approximately 50%) of the incidents, the route of exposure was unspecified. Ninety-four percent of the 164 incidents were accidents which involved children under five years of age. Case histories reported in the literature also report 48% of the exposures to naphthalene were through ingestion* with the other half being through dermal or inhalation routes

---

* The amount of naphthalene ingested ranged from a small portion of one moth ball to ingestion of one or more moth balls.

via clothing or blankets. In these incidents the human health effects range from death or hemolytic anemia to no reported effects. However, the incidents where death occured resulted from misuses of the pesticide. If naphthalene is used in accordance with the labeling statements described in Chapter II.E of this standard, risk to the general population from naphthalene is considered to be minimal.

3) The chemical is judged by EPA to be efficacious in repelling bats from attics and wall spaces.

4) In accordance with FIFRA, the Agency's policy is not to cancel routinely the registration of products or to withhold registration merely for the lack of data (see Sections 3(c)(2)(B) and 3(c)(7) of FIFRA). Rather, the publication of this Standard provides a mechanism for identifying data needs, and registration of naphthalene under this Standard allows for the upgrading of labels during the period in which the required data are being generated. When these data are received, they will be reviewed by the Agency and the registerability of the chemical will be reassessed.

E. Criteria for Registration Under the Standard

To be subject to this Standard, naphthalene products must meet the following conditions:

- contain naphthalene as the sole active ingredient and have the same use patterns described in this Standard;
- bear required labeling; and
- conform to the acute toxicity limits, product composition, and use pattern requirements stated below.

The applicant for registration or reregistration of naphthalene products subject to this Standard must comply with all terms and conditions described in this Standard, including a commitment to fill data gaps on a time schedule specified by the Agency as indicated in Chapter III and, when applicable, offer to pay compensation to the extent required by Sections 3(c)(1)(D) and 3(c)(D) of the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), as amended, 7 U.S.C. 136(c)(1)(D) and 136(c)(2)(D). As discussed in Chapter I and in the Guidance Package, applicants for registration of naphthalene products under this Standard must contact the Agency for specific instructions, including updated information on data requirements, and companies whose data must be cited and to whom compensation must be offered.

1. Manufacturing-Use Naphthalene

a. Acceptable Ranges and Limits

i. Product Composition Standard

To be covered under this Standard, manufacturing-use naphthalene product must conform to the requirements stated below:

Active Ingredient: Any percentage acceptable.

ii. Acute Toxicity Limits

The Agency will consider registration of manufacturing-use naphthalene products in the following toxicity categories indicated by a "yes":

	I	II	III	IV
Acute oral toxicity	Yes	Yes	Yes	Yes
Acute dermal toxicity	Yes	Yes	Yes	Yes
Acute inhalation toxicity	Yes	Yes	Yes	Yes
Primary eye irritation	Yes	Yes	Yes	Yes
Primary dermal	Yes	Yes	Yes	Yes

iii. Use Patterns

To be covered under this Standard, manufacturing-use naphthalene products must be labeled to allow for formulation into end-use insecticides and repellents which are intended only for the following uses:

1) domestic outdoor nonfood (bulb protection);

2) domestic outdoor nonfood (rabbit repellent).

3) domestic indoor nonfood (fumigation);

4) non-domestic indoor (museum specimens);

5) domestic indoor nonfood (bat, bird and rodent repellent)

iv. Required labeling

All manufacturing-use naphthalene products must bear appropriate labeling as specified in 40 CFR 162.10. The Agency may, after review of data to be submitted under this Standard, impose additional label requirements.

Use Pattern Statements

All technical and manufacturing-use naphthalene products must list on the label the intended end-uses of formulated products produced from the manufacturing-use products. In accordance with data to be submitted or cited, all naphthalene product labels must bear one or a combination of the following statements:

1) "For Formulation Into End-Use Fumigant Products Intended Only as a Fumigant for Protection of Ornamental Bulbs (nonfood) During Storage and at Time of Planting";

2) "For Formulation Into End Use Repellent Products for Control of Rabbits".

3) "For Formulation Into End-Use Indoor Nonfood Fumigant Products Intended for Control of Clothes Moths and Carpet beetles";

4) "For Formulation Into End-Use Fumigant Products Intended for Fumigation of Museum Specimens";

5) "For Formulation Into End-Use Repellent Products for Control of Bats, Birds and other Rodents"

Ecological Effects Statements

The following statement must appear on the label of the manufacturing-use products of naphthalene:

> "Do not discharge directly into lakes, streams, ponds or public waters unless in accordance with NPDES permit. For guidance contact your Regional Office of the Environmental Protection Agency."

2. End-Use Naphthalene

   a. Acceptable Ranges and Limits

   i. Product Composition Standard

To be covered under this Standard naphthalene products must conform to the requirements stated below:

Active ingredient:	Any percentage acceptable.
Inert ingredient:	There are no restrictions on inert ingredients when used for nonfood purposes.

   ii. Acute Toxicity Limits

The Agency will consider registration of naphthalene products in the following toxicity categories indicated by a "yes":

The Agency will consider registration of products in toxicity categories I and II when all of the acute toxicity data and other required data appropriate for an amended registration are satisfied. Until the acute data are submitted to the Agency, PIMS data will be used to support warning and use label statements. After receipt and review of the requested data, the Agency may require other appropriate data (e.g., exposure studies, impose additional labeling restrictions, special packaging or deny registration).

	I	II	III	IV
Acute oral toxicity*	yes	yes	yes	yes
Acute dermal toxicity**	yes	yes	yes	yes
Acute inhalation** toxicity	yes	yes	yes	yes
Primary eye** irritation	yes	yes	yes	yes
Primary dermal** irritation	yes	yes	yes	yes

iii. Use Patterns

To be registered under this Standard, naphthalene products must be labeled as an insecticide, fumigant or repellent for one or more of the following nonfood uses: indoor fumigants, museum specimens, bulb protection, rabbits, and, birds bats and tree squirrels.

iv. Required Labeling

All naphthalene products must bear appropriate labeling as specified in 40 CFR 161.10. The Agency may, after review of data to be submitted under this Standard, require additional label requirements.

Ecological Effects Statements

The following statement must appear on all naphthalene products used as repellents and for outdoor domestic uses of naphthalene products under the heading "Environmental Hazards":

"Do not contaminate water by cleaning of equipment or disposal of wastes".

Efficacy Statements

To include statements on naphthalene repellent (birds, bats, and tree squirrels product labels relating to how rapidly the pesticide acts after its application or relating to the duration of its effectiveness, the registrant will be required to submit data supporting those claims. If claims of rapid manifestation of efficacy and duration of effectiveness are not included on, or are removed from the labels, then no data will be required (see Table III.C-3 in Chapter III of this Standard).

---

* If the acute oral LD_{50} for naphthalene is determined to be 1.5 g/kg or less, special packaging may be required.

** If data for naphthalene indicates a toxicity category of I or II, special packaging may be required.

Usage Statements

The following statements must appear on all naphthalene household fumigant products under "Directions for Use"

"Items to be stored should be placed in air-tight containers such as garment bags, trunks, or chests."

"Keep storage space tightly closed."

Precautionary Statements

The following statement must appear on all naphthalene household fumigant products under the heading "Hazard to Humans and Domestic Animals".

Caution May be fatal if swallowed.

Keep out of the reach of children.

Avoid breathing vapors.

When removing articles from storage, clean and air thoroughly before using.

The following statements must appear on all naphthalene outdoor repellent and bulb fumigant products under "Directions for Use":

"Do not use in or around vegetable gardens or food crops."

F. Tolerance Reassessment

The current uses of naphthalene are not subject to a tolerance required under the provisions of the Federal Food, Drug, and Cosmetic Act. Therefore, no tolerance reassessment is necessary for this Standard.

III. Summary of Data Requirements and Data Gaps

Applicants for registration of naphthalene products must cite or submit the information identified as required in the tables in this chapter. The tables applicable to end-use products indicate whether the product to be tested is the technical grade or the formulation. Data generated on one formulation may be used to satisfy the data requirement for a substantially similar formulation based on the chemical composition as indicated by the Confidential Statement of Formula (CSF). Information on which product-specific data requirements are already met is available in the Guidance Package.

Preceeding each requirement, with the exception of Residue Chemistry* and Efficacy*, is listed the Proposed Guideline which describes the data to be submitted. The tables also list when the data are required to be submitted. Justification for why the test is required is provided in the Guidelines (see 43 FR 29696 of July 10, 1978; 43 FR 37336 of August 22, 1978; and 45 FR 72948 of November 3, 1980). A discussion of why data additional to that already submitted are necessary, or why data normally required are not necessary for this chemical, is given in footnotes to the tables. The specified data requirements are the minimum that will be required. Areas where additional data may be required as the result of tiered testing are indicated (see tables for Toxicology, Residue Chemistry, Environmental Fate and Ecological Effects in this Chapter).

Bibliographic citations in the following tables indicate that the listed study accomplishes one of the following:

1) provides all the information required by the guideline requirement;

2) provides partial information required by the guideline requirement;

3) provides specific information that is elaborated on by an accompanying footnote; and

4) a (-) is used to indicate guideline information which is not required because there is no guideline established or because this specific standard does not require the information.

---

* There are currently no Proposed Guidelines for Efficacy. Refer to Chapter I.D for discussion on the data requirements for Residue Chemistry.

Bibliographic citations noted in Chapters IV through IX which are not listed in this Chapter are provided as reference and background material to the reader; they do not relate directly to or satisfy the guideline requirements.

The word "yes" under the heading "Does EPA have data to partially or totally satisfy this requirement?" means that the requirement has been satisfied, unless otherwise noted.

Table A, Generic Data Requirements, includes those data that pertain to the properties or effects of technical naphthalene as an active ingredient. Thus, these data are relevant to an evaluation of the risks of all products containing naphthalene. Providing data to fill indicated gaps in the data base is the primary responsibility of the registrant(s) of manufacturing-use naphthalene. Registrants of end-use products which are not exempted by FIFRA Section 3(c)(2)(D) are also responsible for the submission of these data.

However, applicants for the registration of end-use products containing naphthalene are advised that if the Agency does not receive commitments, within the specified time as indicated in the tables, from manufacturing-use naphthalene registrant(s) to fill data gaps identified for the manufacturing-use product (Table A), manufacturing-use product registrations will be suspended. Formulators must then bear the burden of supplying these data if continued registration of their product is desired.

Applicants for the registration or reregistration of manufacturing-use naphthalene products must acknowledge reliance on existing data which fill indicated data requirements under FIFRA Section 3(c)(1)(D). These data are listed under the column "Bibliographic Citation" in this table.

Table B, Product-Specific Data Requirements for Manufacturing-Use Products, include those data that relate only to the properties or effects of a product with a specific composition (or substantially similar composition). Thus, these data are required of each product (or substantially similar product) to characterize the product's particular composition and physical/chemical properties, and to characterize the product's acute toxicity.

Product composition data, physical/chemical properties and acute toxicity are required for each manufacturing-use product. Providing data to fulfill these requirements is the responsibility of each applicant for the registration or reregistration of a manufacturing-use naphthalene product. If the Agency has data which fulfills this requirement for a particular product(s), then this is indicated in the table and in the Guidance Package accompanying this Standard.

Product-specific data need not be acknowledged under FIFRA Section 3(c)(1)(D) unless the Agency has established that one product is substantially similar to another product for which the Agency has received acceptable data.

Table C, Product-Specific Data Requirements for End-Use Products, include those data that relate only to the properties or effects of a product with a specific composition (or substantially similar composition). Thus, these data are required of each end use product (or substantially similar product) to characterize the product's particular composition and physical/chemical properties, and to characterize the product's acute toxicity.

Product composition data, physical/chemical properties and acute toxicity data are required for each end-use product. Providing data to fulfill these requirements is the responsibility of each applicant for the registration or reregistration of a manufacturing-use naphthalene product. If the Agency has data which fulfills this requirement for a particular product(s), then this is indicated in the table and in the Guidance Package accompanying this Standard.

Product-specific data need not be acknowledged under FIFRA Section 3(c)(1)(D) unless the Agency or a registrant has established that one product is substantially similar to another product for which the Agency has received acceptable data.

Table III.A-1 Generic Data Requirements for Naphthalene, Product Chemistry 1/ (see Chapter IV)

Guideline Citation	Name of Test	Are Data Required for this Standard?	Composition	Does EPA Have Data To Partially Or Totally Satisfy This Requirement?	Bibliographic Citation (MRID#)	Must Additional Data be Submitted Under FIFRA 3(c)2(B)? If so, months allowed for submission from published date of standard.
163.61-7	Product Analytical Methods and Data	Yes	Technical Grade 2/	No	-	Yes, 12 months
163.61-8(1)	Color	Yes	Technical Grade 2/	Yes 3/	-	No
163.61-8(2)	Odor	Yes	Technical Grade 2/	Yes 3/	-	No
163.61-8(3)	Melting Point	Yes	Technical Grade 2/	Yes 3/	-	No
163.61-8(4)	Solubility	Yes	Technical Grade 2/	Yes 3/	-	No
163.61-8(5)	Stability	Yes	Technical Grade 2/	Yes 3/	-	No

Table III.A-1 Generic Data Requirements for Naphthalene, Product Chemistry 1/ (See Chapter IV) (Cont'd)

Guideline Citation	Name of Test	Are Data Required for this Standard?	Composition	Does EPA Have Data To Partially Or Totally Satisfy This Requirement?	Bibliographic Citation (MRID#)	Must Additional Data be Submitted Under FIFRA 3(c)2(B)? If so, months allowed for submission from published date of standard.
163.61-8(7)	Physical State	Yes	Technical Grade 2/	Yes 3/	-	No
163.61-8(8)	Density or Specific Gravity	Yes	Technical Grade 2/	Yes 3/	00004900	No
163.61-8(9)	Boiling Point	Yes	Technical Grade 2/	Yes 3/	00004900	No
163.61-8(10)	Vapor Pressure	Yes	Technical Grade 2/	Yes 3/	-	No

October, 1981

1/ Based on data for technical naphthalene at 99.9% purity or more. Registrants of technical naphthalene with purity of less than 99.9% must submit all data in Table A. All registrants and all applicants for registration or reregistration must submit their supplier's specification sheet for naphthalene.

2/ Nominally 100%, refined grade. Crude grades of naphthalene (< 99.9%) require supplier's specifications.

3/ Pesticide Manual of the British Crop Protection Council (1974) and/or the Merck Index, 9th ed. (1976)

Table III. A-2. Generic Data Requirements for Naphthalene, Environmental Fate (see Chapter V)

Guideline Citation	Name of Test	Are Data Required for this Standard?	Composition	Does EPA Have Data To Partially Or Totally Satisfy This Requirement?	Bibliographic Citation (MRID#)	Must Additional Data be Submitted Under FIFRA 3(c)2(B)? If so, months allowed for submission from published date of standard.
163.62-7(b)	Hydrolysis	No 1/				
163.62-8(b)	Aerobic Soil Metabolism	Yes 2/	Technical or Radiolabeled Analytical Grade	No	-	Yes, 48 months
163.62-8(f)	Microbial Metabolism:		-	-	-	-
	(2) Effects of Microbes on Pesticides	Reserved 2/ 3/	-	-	-	-
	(3) Effects of Pesticide on Microbes	Reserved 2/ 3/	-	-	-	-
163.62-8(g)	Activated Sludge Metabolism	Reserved 2/ 3/	-	-	-	-

Table III. A-2. Generic Data Requirements for Napthalene, Environmental Fate (see Chapter V) (Cont'd)

Guideline Citation	Name of Test	Are Data Required for this Standard?	Composition	Does EPA Have Data To Partially Or Totally Satisfy This Requirement?	Bibliographic Citation (MRID#)	Must Additional Data be Submitted Under FIFRA 3(c)2(B)? If so, months allowed for submission from published date of standard.
163.62-9(d)	Adsorption/ Desorption	reserved 2/ 4/	-	-	-	-
163.62-10(b)	Terrestrial Field Dissipation: (4) Domestic outdoor, parks, ornamental and turf uses	reserved 2/ 4/	-	-	-	-

Table III. A-2 Generic Data Requirements for Naphthalene, Environmental Fate (see Chapter V) (Cont'd)

Guideline Citation	Name of Test	Are Data Required for this Standard?	Composition	Does EPA Have Data To Partially Or Totally Satisfy This Requirement?	Bibliographic Citation (MRID#)	Must Additional Data be Submitted Under FIFRA 3(c)2(B)? If so, months allowed for submission from published date of standard.
163.62-13	Storage and Disposal	Reserved 5/	-	-	-	-

1/ Significant hydrolysis is not expected under guideline test conditions.

2/ The data are needed to support the outdoor domestic use.

3/ The requirement for the submission of these data is currently being reserved pending the Agency's review and modification of the testing protocols.

4/ The requirement for the submission of these data is currently being reserved pending the results and review of the aerobic soil metabolismm testing.

5/ Specific data requirements and testing protocols needed to generate these data are being developed.

Table III. A-3 Generic Data Requirements for Naphthalene, Toxicology (see Chapter VI)

Guideline Citation	Name of Test	Are Data Required for this Standard?	Composition	Does EPA Have Data To Partially Or Totally Satisfy This Requirement?	Bibliographic Citation (MRID#)	Must Additional Data be Submitted Under FIFRA 3(c)2(B)? If so, months allowed for submission from published date of standard.
163.81-1	Acute Oral Toxicity	Yes	Technical Grade	No	-	Yes, 12 months 1/
163.81-2	Acute Dermal Toxicity	Yes	Technical Grade	No	-	Yes, 12 months
163.81-3	Acute Inhalation Toxicity	Yes	Technical Grade	No	-	Yes, 12 months
163.81-4	Primary Eye Irritation	Yes	Technical Grade	No	-	Yes, 12 months
163.81-5	Primary Dermal Irritation	Yes	Technical Grade	No	-	Yes, 12 months
163.81-6	Dermal Sensitization	Yes	Technical Grade	No	-	Yes, 12 mmonths
163.82-3	Subchronic 90-Day Dermal Toxicity	Yes	Technical Grade	No	-	Yes, 24 months
163.82-4	Subchronic Inhalation Toxicity	Yes	Technical Grade	No	-	Reserved 2/
163.83-1	Chronic Feeding	Yes	Technical Grade	No	-	Yes 3/

Table III. A-3 Generic Data Requirements for Naphthalene, Toxicology (see Chapter VI) (Cont'd),

Guideline Citation	Name of Test	Are Data Required for this Standard?	Composition	Does EPA Have Data To Partially Or Totally Satisfy This Requirement?	Bibliographic Citation (MRID#)	Must Additional Data be Submitted Under FIFRA 3(c)2(B)? If so, months allowed for submission from published date of standard.
163.83-2	Oncogenicity	Yes	Technical Grade	No		Yes [3]
163.83-3	Teratogenicity	Yes	Technical Grade	No		Yes, 24 months
163.83-3	Reproduction	Reserved [4]	Technical Grade	No		Reserved [4]
163.84-2,3,4	Mutagenicity	Yes	Technical Grade	No		Yes [3]
163.85-1	Metabolism	Yes	Technical Grade	Yes	05020080	No

October, 1981

---

[1] Acute oral toxicity data are being generated by the National Cancer Institute. When these data have been reviewed and found acceptable, this data requirement may be waived.

[2] The need for this data requirement will be assessed when acute inhalation toxicity data are available.

[3] Naphthalene is currently undergoing chronic oncogenicity and mutagenicity testing by the National Toxicology Program, (NTP). The EPA and the NTP are coordinating their efforts to ensure that guideline requirements will be satisfied as a result of these tests. However, if data requirements are not satisfied, the registrants will be required to submit additional data.

[4] The reproductive studies are reserved pending the completion of the National Toxicology Program Testing. Upon completion of the National Toxicology Program testing, the Agency will reevaluate the need for reproductive studies on naphthalene (see rationale in Chapter VI.D).

Table III. A-4 Generic Data Requirements for Naphthalene, Ecological Effects (see Chapter VIII)

Guideline Citation	Name of Test	Are Data Required for this Standard?	Composition	Does EPA Have Data To Partially Or Totally Satisfy This Requirement?	Bibliographic Citation (MRID#)	Must Additional Data be Submitted Under FIFRA 3(c)2(B)? If so, months allowed for submission from published date of standard.
163.71-1	Avian Single Dose Oral LD_{50}	Yes	Technical Grade	No	-	Yes, 24 months
163.71-2	Avian Dietary LC_{50}	Yes 1/	Technical Grade	No	-	Yes, 24 months
163.72-1	Fish Acute LC_{50}	Yes 2/	Technical Grade	No	-	Yes, 24 months
163.72-2	Acute Toxicity to Aquatic Invertebrates	Yes	Technical Grade	No	-	Yes, 24 months

October, 1981

1/ Given the extremely small naphthalene exposure to fish and wildlife, upland game species LC_{50} study is waived. One LC_{50} study will be required however on a mallard duck.

2/ Given the extremely small naphthalene exposure to fish and wildlife, the bluegill trout 96 hour LC_{50} study is waived. One LC_{50} study will be required however on a coldwater fish species (rainbow trout).

Table III.B-1 Product-Specific Requirements for Manufacturing-Use Products, Product Chemistry 1/ (see Chapter IV).

Guideline Citation	Name of Test	Are Data Required for this Standard?	Composition	Does EPA Have Data To Partially Or Totally Satisfy This Requirement?	Bibliographic Citation (MRID#)	Must Additional Data be Submitted Under FIFRA 3(c)2(B)? If so, months allowed for submission from published date of standard.
163.61-3	Product Identity and Disclosure of Ingredients	Yes	Each Manufacturing-Use Product	Yes 2/	-	No
163.61-4	Description of Manufacturing Process	Yes	Each Manufacturing-Use Product	Yes 3/	005010379 050008684	No
163.61-5	Discussion on Formation of unintentional Ingredients	Yes	Each Manufacturing-Use Product	Partial 4/	-	Yes, 12 months
163.61-6	Declaration and Certification of Ingredient Limits	Yes	Each Manufacturing-Use Product	No	-	Yes, 8 months
163.61-7	Product Analytical Methods and Data	Yes 5/	Each Manufacturing-Use Product	No	-	Yes, 12 months

Table III.B-1 Product-Specific Requirements for Manufacturing-Use Products, Product Chemistry [1] (see Chapter IV) (Cont'd)

Guideline Citation	Name of Test	Are Data Required for this Standard?	Composition	Does EPA Have Data To Partially Or Totally Satisfy This Requirement?	Bibliographic Citation (MRID#)	Must Additional Data be Submitted Under FIFRA 3(c)2(B)? If so, months allowed for submission from published date of standard.
163.61-8(7)	Physical State	Yes	Each Manufacturing-Use Product	Yes [6]	[7]	No
163.61-8(8)	Density or Specific Gravity	Yes	Each Manufacturing-Use Product	Yes [6]	[7]	No
163.61-8(12)	Storage Stability	Yes	Each Manufacturing-Use Product	No	-	No [8]
163.61-8(13)	Flammability	Yes	Each Manufacturing-Use Product	Yes [6]	-	No [8]
163.61-8(14)	Oxidizing/ Reducing Action	Yes	Each Manufacturing-Use Product	No	-	No [8]

Table III.B-1 Product-Specific Requirements for Manufacturing-Use Products, Product Chemistry 1/ (see Chapter IV) (Cont'd)

Guideline Citation	Name of Test	Are Data Required for this Standard?	Composition	Does EPA Have Data To Partially Or Totally Satisfy This Requirement?	Bibliographic Citation (MRID#)	Must Additional Data be Submitted Under FIFRA 3(c)2(B)? If so, months allowed for submission from published date of standard.
163.61-8(15)	Explosiveness	Yes	Each Manufacturing-Use Product	No	-	No 7/
163.61-8(18)	Corrosion Characteristics	Yes	Each Manufacturing-Use Product	No	-	No 7/

October, 1981

1/ Registrants of new manufacturing use products are not required to submit data if the new product is identical or substantially similar to currently registered manufacturing use products.

2/ The Agency has information to fulfill this requirement for currently registered manufacturing-use products; EPA Reg. No. 1475-20 and EPA Reg. No. 9121-3 [information was provided in the Confidential Statement of Formula (CSF)].

3/ This data requirement is fulfilled for currently registered manufacturing-use products, EPA Reg. No. 1475-20 and EPA Reg. No. 9121-3.

4/ For manufacturing use products which contain 99.0% or more naphthalene, this data requirement is considererd to be satisfied (manufacturing use products with 99% active ingredient are considered substantially similar to 99.9% active ingredient naphthalene) All applicants for registration or reregistration are required to submit their supplier's specification sheet for naphthalene.

5/ The information required on the technical and manufacturing use products need only be submitted for one product where they are identical.

6/ The Agency has information for manufacturing use products containing, at a minimum, 99.9% naphthalene; manufacturing use products with 99.0% active ingredient are considered substantially similar to 99.9% active ingredient naphthalene.

7/ Merck Index, 9th edition (1976). Because the manufacturing use naphthalene proucts contain 99.0% or more naphthalene, these data requirements are waived as the information is available in the open literature (See Chapter IV.E).

8/ Based upon the physical-chemical characteristics of naphthalene, this requirement is being waived for 99.0% or greater active ingredient in naphthalene.

Table III B-2 Product-Specific Requirements for Manufacturing-Use Products, Toxicology [1] (see Chapter VI)

Guideline Citation	Name of Test	Are Data Required for this Standard?	Composition	Does EPA Have Data To Partially Or Totally Satisfy This Requirement?	Bibliographic Citation (MRID#)	Must Additional Data be Submitted Under FIFRA 3(c)2(B)? If so, months allowed for submission from published date of standard.
163.81-1	Acute Oral Toxicity	Yes	Each Manufacturing-Use Product	No	-	Yes, 12 months [2]
163.81-2	Acute Dermal Toxicity	Yes	Each Manufacturing-Use Product	No	-	Yes, 12 months
163.81-3	Acute Inhalation Toxicity	Yes	Each Manufacturing-Use Product	No	-	Yes, 12 months
163.81-4	Primary Eye Irritation	Yes	Each Manufacturing-Use Product	No	-	Yes, 12 months
163.81-5	Primary Dermal Irritation	Yes	Each Manufacturing-Use Product	No	-	Yes, 12 months
163.81-6	Dermal Sensitization	Yes	Each Manufacturing-Use Product	No	-	Yes, 12 months

---

[1] The chemical composition of technical naphthalene and manufacturing use naphthalene are identical. Therefore data submitted in response to the "A Tables" will also satisfy the data requirements on the "B Table".

[2] Acute oral toxicity data are being generated by the National Cancer Institute. When these data have been reviewed and found acceptable this data requirement may be waived.

Table III.C-1 Product-Specific Requirements for End-Use Products, Product Chemistry 1/ (See Chapter IV)

Guideline Citation	Name of Test	Are Data Required for this Standard?	Composition	Does EPA Have Data To Partially Or Totally Satisfy This Requirement?	Bibliographic Citation (MRID#)	Must Additional Data be Submitted Under FIFRA 3(c)2(B)? If so, months allowed for submission from published date of standard.
163.61-3	Product Identity and Disclosure of Ingredients	Yes	Each Product	Yes 2/	-	No
163.61-4	Description of Manufacturing Process	Yes	Each Product	Partial 3/	-	Yes, 8 months
163.61-5	Discussion of Formation of Unintentional Ingredients	Yes 4/	Each Product	Partial	-	Yes 5/
163.61-6	Declaration and Certification of Ingredient Limits	Yes	Each Product	No	-	Yes, 8 months
163.61-7	Product Analytical Methods and Data	Yes	Each Product	No	-	Yes, 12 months

Table III.C-1 Product-Specific Requirements for End-Use Products, Product Chemistry [1] (see Chapter IV) (Cont'd)

Guideline Citation	Name of Test	Are Data Required for this Standard?	Composition	Does EPA Have Data To Partially Or Totally Satisfy This Requirement?	Bibliographic Citation (MRID#)	Must Additional Data be Submitted Under FIFRA 3(c)2(B)? If so, months allowed for submission from published date of standard.
163.61-8(1)	Color	Yes	Each Product	Yes	-	No [6]
163.61-8(2)	Odor	Yes	Each Product	Yes	-	No [6]
163.61-8(7)	Physical State	Yes	Each Product	Yes	-	No [6]
163.61-8(8)	Density or Specific Gravity	Yes	Each Product	Yes	-	No [6]
163.61-8(12)	Storage Stability	Yes	Each Product	No	-	No [7]
163.61-8(13)	Flammability	Yes	Each Product	Yes	-	No [6]

Table III.C-1 Product-Specific Requirements for End-Use Products, Product Chemistry 1/ (see Chapter IV) (Cont'd)

Guideline Citation	Name of Test	Are Data Required for this Standard?	Composition	Does EPA Have Data To Partially Or Totally Satisfy This Requirement?	Bibliographic Citation (MRID#)	Must Additional Data be Submitted Under FIFRA 3(c)2(B)? If so, months allowed for submission from published date of standard.
163.61-8(14)	Oxidizing or Reducing Action	Yes	Each Product	No	-	No 7/
163.61-8(15)	Explosiveness	Yes	Each Product	No	-	No 7/
163.61-8(18)	Corrosion Characteristics	Yes	Each Product	No	-	No 7/

October, 1981

1/ The chemical composition of technical and manufacturing use naphthalene are substantially similar. Data submitted in response to the A or B Tables will satisfy the data requirements on the C Table unless the active ingredient is less than 99.0% (99.0% naphthalene is considered substantially similar to 99.9% naphthalene).

2/ The Agency has information to support all currently registered end-use products containing 99.9% or more active ingredient naphthalene [information is provided in the Confidential Statement of Formula (CSF)]. All naphthalene products containing less than 99.9% naphthalene active ingredient will require an updated Confidential Statement of Formula (CSF).

3/ The Agency does not have data describing the formulation process. Data which are available describe the manufacturing process for 99.9% naphthalene. Therefore, this requirement is fulfilled for those end-use products containing 99.9% naphthalene.

4/ All applicants for registration or reregistration are required to submit their suppliers specification sheet for naphthalene.

5/ For those end-use products which contain 99.9% or more naphthalene, this data requirement is considered as satisfied.

6/ Because the end-use naphthalene products contain 99.0% or more naphthalene and are considered substantially similar to 99.9% naphthalene, these data requirements are waived as they are available in the open literature (See Merck Index, 9th edition (1976)).

7/ Based upon the physical/chemical characteristics of naphthalene, this requirement is being waived for products containing 99.0% naphthalene (for these data, 99.0% naphthalene end use products are considered substantially similar to 99.9% naphthalene).

Table III C-2 Product-Specific Requirements for End-Use Products, Toxicology [1] (see Chapter VI)

Guideline Citation	Name of Test	Are Data Required for this Standard?	Composition	Does EPA Have Data To Partially Or Totally Satisfy This Requirement?	Bibliographic Citation (MRID#)	Must Additional Data be Submitted Under FIFRA 3(c)2(B)? If so, months allowed for submission from published date of standard.
163.81-1	Acute Oral Toxicity	Yes	Each Product	No	-	Yes, 12 months [2]
163.81-2	Acute Dermal Toxicity	Yes	Each Product	No	-	Yes, 12 months
163.81-3	Acute Inhalation Toxicity	Yes	Each Product	No	-	Yes, 12 months
163.81-4	Primary Eye Irritation	Yes	Each Product	No	-	Yes, 12 months
163.81-5	Primary Dermal Irritation	Yes	Each Product	No	-	Yes, 12 months
163.81-6	Dermal Sensitization	Yes	Each Product	No	-	Yes, 12 months

October, 1981

---

[1] The chemical composition of technical and manufacturing use naphthalene are substantially similar. Therefore data submitted in response to the A or B Tables will satisfy the data requirements on the C Table unless the active ingredient is less than 99.0% (99.0% naphthalene is considered substantially similar to 99.9% naphthalene).

[2] Acute oral toxicity data are being generated by the National Cancer Institute. When these data have been reviewed and found acceptable this data requirement may be waived.

Table III C-3 Product-Specific Requirements for End-Use Products, Efficacy (see Chapter IX)

Site	Name of Pest	Are Data Required for this Standard?	Composition	Does EPA Have Data To Partially Or Totally Satisfy This Requirement?	Bibliographic Citation (MRID#)	Must Additional Data be Submitted Under FIFRA 3(c)2(B)? If so, months allowed for submission from published date of standard.
Attics Between	Bats	Yes	Each Product	Yes	GS0022025, GS0022026, GS0022028, GS0022029, GS0022030, GS0022031, GS0022032, GS0022033, GS0022034,	No [1]
Attics Between Walls	Birds, including Pigeons, Starlings, Sparrows	Yes	Each Product	Yes	GS0022025, GS0022026, GS0022028 GS0022029, GS0022030, GS0022031, GS0022032, GS0022033, GS0022034,	No [1]

---

[1] Registrants will be required to supply supporting data to include claims on a product label relating to the period between application of the pesticide and manifestation of its efficacy or relating to the duration of effectiveness.

IV. Product Chemistry

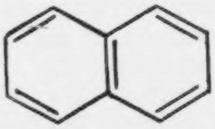
A. Introduction

The Agency published "Proposed Guidelines for Registering Pesticides" which explains the minimum product chemistry requirements for registering pesticide products in the United States (see 43 FR 29696, July 10, 1978). The Agency requires information on chemical identity, manufacturing process, active ingredient limits in pesticides products, product analytical method and data, and physical/chemical properties, in order to assess a pesticide's product chemistry. In the case of naphthalene, the information required on the technical and manufacturing use products need only be submitted for one product. This is because the chemical composition of technical naphthalene and the manufacturing use product are considered identical (99.9 - 100% active ingredient (a.i.)). Further, most of the end-use products also have the same chemical composition as the manufacturing-use products. When this is the case, or where the 99.0% a.i. is considered substantially similar to the 99.9% a.i. The data submitted for the technical material may also be used to support the registration of the end-use products. With regard to product chemistry, there are a few end use products which vary slightly in chemical composition from the manufacturing-use product. For these end-use products separate data requirements may be required. These data requirements are identified in Tables III.A-1, III.B-1, and III.C-1.

B. Chemical Identity

The Agency requires identifying information including chemical names, product names, and numerical codes of all substances known or assumed to be present in pesticide products.

As discussed in Chapter II.B, naphthalene is the chemical name, and is the name by which this chemical substance is generally known. The empirical formula for naphthalene is $C_{10}H_8$ (Martin and Miles, 1953, MRID #005010941); it has a molecular weight of 128.16 and its chemical structure is shown below:



The Chemical Abstracts Registry (CAS) number for naphthalene is 91-20-3, and the EPA Shaughnessy number is 055801. Thus, the nomenclature of naphthalene has been adequately defined.

C. Manufacturing Process

Because the process by which the pesticide is produced influences the nature and amount of potentially toxic impurities, a detailed description of the manufacturing process is required.

Prior to 1961 naphthalene was derived from coal tar, and from 1961 to the present it has been derived from crude petroleum (Ballard, 1965, MRID# 005010379; Liepins, et al.,1977, MRID# 005008684). It is obtained from petroleum distillates by a hydrodealkylation process (removal of an attached alkyl group by saturation of the fragments with hydrogen using a catalyst and high temperatures as in the Hydeal and Unidak Process). The resulting product may be further fractionated and/or cooled to induce crystallization. Filtration or centrifugation yields the crude naphthalene. Purification may be achieved by pressing, or washing with sulfuric acid, formaldehyde, alkali, and water with redistillation or sublimation (for high purity), (Ballard, 1965, MRID# 005010379; Liepins, et al.,1977, 0050008684).

Naphthalene is commercially available as an industrial chemical and is purchased by registrants for use in their pesticide products. Under these conditions, the requirements regarding a description of the manufacturing process have been adequately defined. However, the requirement of the Proposed Guidelines as to the description of impurities that exceed 0.1% may or may not be fulfilled depending on the purity of the naphthalene. For any degree of purity less than 99.9%, the description of impurities data requirements are not fulfilled and a data gap exists. All applicants/registrants must furnish the Agency with a copy of their supplier's specifications on the composition of naphthalene.

In addition, the Guidelines require upper and lower limits be established for each active ingredient in a pesticide product and require registrants to certify that the limits will be maintained for all quantities of the product sold or distributed in commerce (40 CFR Section [163.61-6).

Upper and lower limits have not been established and certified for any product containing naphthalene. Refined grades at nominally 100% purity are usually used in fumigants and single active ingredient repellents. For purpose of this Standard, only products containing naphthalene as the sole active ingredient are considered. The Confidential Annex lists the available products which have naphthalene as the sole active ingredient.

D. Product Analytical Methods and Data

No analytical methods have been submitted to the Agency to determine naphthalene in any pesticide product. Many methods are described in the literature and some of them may be adopted to satisfy this guideline requirement. However, the lack of data submitted for this purpose constitutes a data gap. The Agency needs analytical methods for naphthalene analysis in the manufacturing-use product and in the end-use formulations because these products may contain inert ingredients which affect the chemical analytical results; the available literature describes the analytical analysis of naphthalene in the pure state. If the percentage of active ingredient is the same for both the manufacturing use and end use products, only one analytical method need be submitted.

E. Physical/Chemical Properties

Naphthalene may be repackaged or reformulated. Thus, for the purposes of this Standard, naphthalene may be considered a technical material, a manufacturing-use product, an end-use product, or an active ingredient of an end-use product. As discussed in Chapter IV.A, technical grade and manufacturing-use naphthalene products are identical in composition and the end-use or formulated products of naphthalene may also be identical to the manufacturing-use products. For the purpose of the standard, this is considered the case if the end use product's active ingredient is 99.9%

or greater naphthalene. Formulated products whose active ingredients range from 99.0 to 99.9% naphthalene are considered substantially similar and some of the data used to support the technical naphthalene will also be used to support the end-use products see Tables III.A-1, III.B-1 and III.C-1.

Because naphthalene used in pesticide products is in a high state of purity, the usual requirements for physical chemical properties are waived when these are available in the literature.

Color: Colorless (white)*

Odor: Aromatic*

Melting Point: 80.0°C (Nowak, 1975, MRID #000004900), 80.2C°*

Solubility: Solubility in water is 30 ppm at room temperature. One gram dissolves in 13 ml methanol or ethanol, and in 3.5 ml benzene or toluene.*

Stability: Inflammable, and stable.*

Physical state: Crystals, flakes, powder, balls or cakes.*

Density or specific gravity: d_4^{20} 1.162*

Boiling point: 217.9°C at 760 mm Hg.*

Vapor Pressure: 4.92 x 10^{-2} mm Hg at 20°C (Volatilizes at room temperature; sublimes above melting temperature)*.

Flash Point: Open cup, 174°F (79°C)*
Closed cup, 190°F (88°C)*

---

* "Pesticide Manual of the British Crop Protection Council," H. Martin and C.B. Worthing, ed., 9th edition, London, England (1974); and "Merck Index", 9th ed., Merck and Co., Rahway, N.J. (1976).

F. Summary of Data Gaps

The possible formulation of unintentional ingredients is a data gap for manufacturing-use and end-use naphthalene. All applicants for registration or reregistration are required to submit their suppliers' specification sheet for naphthalene. The upper and lower limits for naphthalene have not been established and certified for manufacturing- and end-use products containing naphthalene. In addition, a description of the formulation process of the end-use products has not been submitted to the Agency.

Analytical methods for naphthalene in the technical material and naphthalene in end-use formulations have not been submitted to the Agency.

The storage stability, oxidizing or reducing action, explosiveness, and corrosion characteristics data requirements on the manufacturing- and end-use products which contain 99.0% or more naphthalene are waived based on the Agency's knowledge of the physical-chemical characteristics of naphthalene.

V. Environmental Fate

A. Use Summary

Naphthalene is a general household insecticidal fumigant for use against clothes moths and carpet beetles. Minor use patterns of naphthalene are: protection of bulbs during storage and planting; fumigation of museum specimens (dried insects and stuffed animals); and a repellent of bats, pigeons, sparrows, squirrels and starlings in dormers and eaves, and rabbits in gardens. Naphthalene has no registered food uses.

The percentages of naphthalene in the various formulations are as follows: crystalline naphthalene: 99.99, 99.75, 99.50, and 99.0%; Pellet/tableted naphthalene: 99.50%. The remaining 0.01 to 1.0% are essential oils and perfumes.

Crystalline naphthalene is used in the form of flakes, balls and cakes predominantly for control of clothes mothes and carpet beetles. Less than 1% of the pesticidal use of naphthalene is used as a repellent or to protect bulbs during storage and planting or to repel rabbits from gardens. The household fumigant rates of application range from 1.0 lbs naphthalene/100 cu. ft. to 4.0 lbs/100 cu ft. The recommended frequency of application is 6 months or is unspecified. The rates of application to protect stored bulbs range from 3.75 lbs naphthalene per 100 cu. ft. to 4.0 lbs/100 cu. ft. The frequency of application is once before storing. The rate of application for treatment of bulbs at planting is unspecified. The recommended frequency of application is a single application per planting.

The rate of application for repellents in eaves and dormers is 5.0 lbs naphthalene/2000 cu ft. The frequency of application is unspecified.

The Agency estimates that the total pesticidal usage of naphthalene as a single active ingredient is between 6 to 10 million lbs/year*. The quantity of naphthalene used for protection of bulbs during storage and planting** and the single active ingredient repellent uses are minor use patterns. At one time naphthalene was used more widely in moth control; however commercial competition from p-dichlorobenzene, moth proofing material, and the increasing substitution of synthetic fibers for wool have resulted in a steady decline in the demand for naphthalene as a pesticide.

B. Environmental Fate Profile

The available data are insufficient to assess the environmental fate of naphthalene.

Preliminary studies showed bioaccumulation factors for *Mytilus edulis* (blue mussel), *Daphnia pulex*, and *Crassostrea virginica* (oyster) of 25-40, 130, and

---

* Scarato, R., "Preliminary Quantitative Usage Analysis of Naphthalene", EAB, BFSD, EPA 1980

** Personal communication with registrants.

6,000, respectively, after exposure to < 1 ppm naphthalene (Southworth et al., 1978, MRID #005018634; Hansen et al., 1978, MRID #005019904; Lee et al., 1978, MRID #005006779). Several species of marine/estuarine copepods, including Calanus helgolandicus and Eurytemora affinis, were also shown to readily accumulate naphthalene (Corner et al., 1976, MRID #005007545, Harris et al., 1977, MRID #005009021, and Harris et al., 1977, MRID #005006550). In all these species, depuration was rapid.

Available volatility data indicate that crystalline naphthalene (99.9% active ingredient) volatilizes at a rate of 1.86 g/surface m^2/h when air temperature and speed are 15-19 C and 0.2 m/s, respectively (Bramson, 1960, MRID #005017183). Naphthalene dissolved in water volatilizes with a half-life of 3 and 8 hours at 25° and 19° C, respectively (Mackay and Wolkoff, 1973, MRID #005005660 and Soto et al., 1977, MRID #005006598).

The use patterns and low volume usage for the outdoor domestic uses of naphthalene on ornamental plants and as a rabbit repellent indicate that large quantities of this chemical will not be introduced into or on the soil. In addition, loss of naphthalene via volatilization and microbial metabolism would tend to limit the persistance of naphthalene in or on soil. (Mackay and Wolkoff, 1973, MRID #005005660; Shtein et al., 1976, MRID #005012039; Soto, et al., 1977, MRID #005006598; Cerniglia and Gibson, 1977, MRID #005005354; Cerniglia and Gibson 1978, MRID # 005005353; Cerniglia, et al.,1978, MRID #005005937; Cundell and Traxler, 1973, MRID #005007776; Cundell and Traxler, 1973, MRID #005012107; Cundell and Traxler, 1976, MRID #005008688; Kaneko, et al., 1969, MRID #005014797; Kvasnikov, et al., 1970, MRID #005016326; Losane, et al., 1974, MRID #005006197, Losane, et al., 1976, MRID #005006198; Lopatick, 1974, MRID #005015494; Skryobin and Starovoitov, 1975, MRID #005015998; Slavnina, 1970, MRID #005017304; Starovoitov, et al., 1974-1975, MRID #005009267; Traxler, 1973, MRID #005017184; and Walker and Colwell, 1976, MRID #005005371).

C. Exposure Profile

A human exposure profile cannot be generated at the present time (September, 1981) because of the scarcity of data.

The principal population at risk is expected to be the homeowner, as the major use of naphthalene is for clothes moth control. The Agency estimates that 26 x 10^6 persons use fumigants to protect household articles and one third of these products contain naphthalene..

The volatility of naphthalene enhances the potential for respiratory exposure. Respiratory exposure to naphthalene is expected to be the highest when the compound is used indoors. However, no data are available to assess the level of such exposure (Bramson, 1960, MRID #005017183). Dermal exposure while handling naphthalene also cannot be assessed due to lack of data.

Although data on the exposure of humans via contamination of groundwater from pesticide use is not available, the potential appears to be low, due to the limited outdoor use of naphthalene.

In summary, no data are available to quantify the magnitude of dermal and respiratory naphthalene exposure to persons handling and applying naphthalene, and to persons living or working in treated areas (museums).

D. Summary of Data Gaps

The environmental fate data gaps for the outdoor domestic use of naphthalene are: hydrolysis, aerobic soil metabolism, terrestrial field dissipation, and adsorption/desorption. Hydrolysis data will not be required as naphthalene is not expected to hydrolyze sifnificantly under test conditions. Further, due to the limited outdoor use of naphthalene, only aerobic soil metabolism data are required at this time, (see Table III.A-2). The terrestrial field dissipation and adsorption/desorption data requirements are reserved pending the results of the aerobic soil metabolism testing.

While there are no data available to assess human exposure to naphthalene, the Agency is not requesting human exposure data at this time.

There are data gaps for disposal and storage, microbial metabolism and activated sludge. However, pending the Agencys' review and possible modification and development of the testing protocols, it is currently not necessary to satisfy these data gaps. Further testing details are in Table III. A-2.

VI. Toxicology

A. Toxicology Profile: Technical Naphthalene

No data were available to assess the acute dermal and acute inhalation toxicities of naphthalene.

In a supplementary study* by Adams (1930, MRID #005015698), 4 rats were given 2.5-3g naphthalene (in paraffin) orally and 1 death was observed. These data suggest that the acute oral toxicity of naphthalene is low; however the study is insufficient** to fulfill the acute oral toxicity testing requirement for naphthalene

No data were available to assess the primary dermal irritation and the dermal sensitization potential of naphthalene.

Insufficient data were available with respect to the eye irritation potential of naphthalene. In a study by D'Asaro Biondo (1973, MRID #005019746), rabbits with partially removed nictitating membranes exhibited severe eye irritation when exposed to the vapors of naphthalene for 3 or 10 minutes. However, the inadequacies in the methodology used in this study precludes the use of the study to assess the primary eye irritation potential for naphthalene.

The subchronic toxicity of naphthalene could not be adequately assessed. In a subchronic oral toxicity study in rats, the maximum tolerated dose (MTD) was estimated to be 200 mg/kg/day, (Battelle Columbus Laboratories, 1980, MRID #GS0022023 and GS0022024). However, subchronic oral toxicity testing is not required for naphthalene since repeated human exposure through the oral route is unlikely with this pesticide.

No subchronic dermal toxicity data were available for naphthalene, and no data were available to assess the subchronic inhalation toxicity of naphthalene. An assessment of the subchronic inhalation data requirement will be made once data for acute inhalation toxicity are available.

---

* "Supplementary" studies and/or "supplementary" data provide some valid information, but do not satisfy a Guideline requirement.

** Acute oral toxicity data may be available from the NCI and these data may satisfy the acute toxicity testing requirement.

Insufficient data were available to assess the chronic effects of naphthalene. In a study by Schmaehl (1955, MRID #005015285), rats fed 10 to 20 mg of naphthalene in the diet, 6 times per week, for approximately 700 days, or 20 mg of naphthalene given to rats by intraperitoneal or subcutaneous injection once a week for 40 weeks, did not produce toxicity, tumors, or affect the life span. While this study was inadequate to permit an assessment of the chronic toxicity of naphthalene due to deficiencies in reporting and methodology, the data suggested that chronic low dose exposure to naphthalene is well-tolerated in rats.

Naphthalene is scheduled to be tested by the National Toxicology Program for oncogenicity, chronic feeding, and mutagenicity.As of publication of this standard, (September 1981) no data were available to assess the mutagenic potential of naphthalene. When the NTP testing is completed, the Agency will evaluate it to determine if the results satisfy the FIFRA guideline testing requirements for oncogenicity, chronic feeding and mutagenicity.

No data were available to assess the teratological potential or the reproductive toxicity potential of naphthalene. Teratology testing in two mammalian species is required. The reproductive toxicity data requirement is being held in reserve until all of the acute and chronic toxicity data mentioned above as well as teratology data requested from the registrants are available. At that time, a toxicological assessment can be made of the need for a reproductive test.

A number of investigators have provided supplementary information about the metabolism of naphthalene in rats, rabbits, mice, hamsters, guinea pigs, and humans. Table VI. 1 lists naphthalene metabolites that have been identified in the urine of naphthalene-dosed animals. Adequate data were available to assess the metabolism of radiolabeled naphthalene in rats. In a study by Chen and Dorough (1979, MRID #005020080) it was demonstrated that the metabolism of naphthalene occurs by (at least) a two phase elimination process. In the initial rapid phase, approximately 74% of the naphthalene is eliminated; urinary exretion accounts for approximately 60% of this elimination while fecal excretion accounts for approximately 14%. The major urinary metabolite is N-acetyl-S-(1,2-dihydro-2-hydroxyl-1-naphthyl) cysteine, a premercapturic acid. Tissue accumulation (greater than 20%) accounts for the slow elimination of naphthalene in the second phase. While these and additional in vitro studies indicate the presence of metabolic intermediates of naphthalene which may be of toxicological concern, the full significance of these materials cannot be evaluated until the chronic testing data are available for review.

B. Toxicology Profile: End-Use Naphthalene

The Confidential Statements of Formula do not indicate an anticipated change in toxicity due to inert ingredients; see Chapter IV. Introduction, for rationale. Separate discussions or profiles of naphthalene end-use products, therefore, will not be included in this standard.

TABLE VI.1
NAPHTHALENE URINARY METABOLITES

Metabolites	Rabbit	Guinea Pig	Mice	Rat	Hamster	Man	Citation
							1 = MRID: 005005367
1-Naphtol	1,3,5	1	1	1,3,7, 8,10		9	2 = MRID: 005005368
2-Naphthol	1,5	1	1	1,7,8		9,11	3 = MRID: 005006213
1,2-dihydro-1,2-dihydroxy naphthalene	1	1	1	1,7,8			4 = MRID: 005006208
1-naphthyl sulfate	1,3,4	1	1	1,3			5 = MRID: 005006209
1-naphthylmercapturic acid	4	1	1	6			6 = MRID: 005007954
1-naphthylglucosiduronic acid	1,3		1	1,3			7 = MRID: 005005671
1,2-dihydro-2-hydroxy-1-naphthyl-glucosiduronic acid	2			1,10			8 = MRID: 005005672
1,2-dihydro-1,2-dihydroxy-1-naphthal sulfate				10			9 = MRID: 005005949 10 = MRID: 00502080
N-acetyl-S-(1,2-dihydro-2-hydroxy-1-naphthyl)-L-cysteine	5	5	5	5,10	5	5	11 = MRID: 005012927
2-hydroxy-1-naphthyl sulfate	5						
1-hydroxy-2-naphthyl sulfate	4						
1,2-dihydroxynaphthalene				3,8			
1,2-naphthaquinone						9	
1,4-naphthaquinone						9	
methylthionaphthalene				7,8			

43-a

C. Human Hazard Assessment: Naphthalene

The use of naphthalene may result in human exposure through the dermal and inhalation routes. However, at present, no adequate exposure or toxicology data are available to perform a human hazard assessment on naphthalene. Supplementary data describing the cataractogenic and hemolytic effects of naphthalene were available. Naphthalene-induced cataracts have been produced experimentally in rats and rabbits; rabbits appear to be the more sensitive species. Single high oral doses of naphthalene (1-3g) have been shown to cause eye damage and/or opacities in rabbits as early as 6 hours to one week following treatment. (Adams, 1930, MRID #005015698 and Pirie, 1968, MRID #0050005197).

In humans, the hemolytic properties of naphthalene have been well documented. Case histories report incidents of acute hemolytic anemia in humans following naphthalene poisoning. Persons with glucose-6-phosphate dehydrogenase deficiencies appear to be more susceptable to this type of toxicity. In addition, naphthalene induced acute hemolytic anemia has been observed experimentally in dogs (Zuelzer and Apt, 1949, MRID #005005235; and Mackell et al., 1951, MRID # 005005949). It should be noted that this effect has generally been observed, following high dose exposure or misuses of the pesticide.

D. Summary of Data Gaps

The data gaps for technical grade and end-use naphthalene are acute oral toxicity, acute dermal toxicity, acute inhalation toxicity, primary eye irritation, primary dermal irritation, and dermal sensitization. The data gaps for technical naphthalene are teratogenicity, and subchronic dermal toxicity.

Oncogenicity (in the rat and mouse), chronic feeding, mutagenicity and reproduction data are also insufficient to meet the guidelines requirements and would normally be required. Naphthalene, however, is scheduled to be tested under the National Toxicology Program. This testing will most likely encompass the required oncogenicity, mutagenicity and chronic feeding studies.

Therefore, at this time the Agency will not require oncogenicity, chronic feeding, and mutagenicity studies.*

In addition, the Agency has decided to reserve its decision to require reproductive testing with naphthalene until the results of all the above cited studies are available, and a toxicological assessment of the need for a reproductive test can be made.

---

* If naphthalene is not tested under the NTP, the registrants may be required to submit the outstanding chronic studies.

VII. Residue Chemistry

An allowable residue level (tolerance) for specific chemicals is determined by the Agency for the commodities on which they may occur. Since no naphthalene product is currently registered for use on food or feed crops, its use should not result in such residues. Therefore, there are no residue chemistry data requirements for this chemical.

VIII. Ecological Effects

A. Ecological Effects Profile

No acceptable data were available for the evaluation of manufacturing-use* and end-use products of naphthalene with respect to effects on non-target fish and wildlife species.

Several studies did provide supplementary information on the potential effects of crystalline naphthalene on non-target plants. Forty-three plant types showed no effect in the greenhouse when exposed to air saturated to 13% with naphthalene vapors. These plants included vegetables, grasses, and ornamentals. However, slight to severe injury was observed on soybeans, buckwheat, and tabasco pepper (Hartzell 1930, MRID #005007239).

In another study, one variety of chrysanthemum showed no adverse effects when sprayed with a 50% solution of naphthalene. A second variety was not adversely affected when a 100% solution was used (Kofranek, 1967, MRID #005015700).

In a third study, naphthalene mixed with maize seed and stored for several months caused no adverse effects on germination (Moutia, 1943, MRID #005009023).

---

* Technical naphthalene and manufacturing-use naphthalene are considered to be substantially similar.

B. Hazard Assessment

There are two outdoor uses of naphthalene in a single active ingredient formulation. Crystalline naphthalene is used to protect bulbs during storage and at the time of planting, and to repel rabbits from gardens. It is possible that exposure to non-target terrestrial wildlife could result from crystals being ingested directly or along with typical dietary matter. However, because of its repellency characteristics and its localized use, it is highly unlikely that these outdoor end-uses of naphthalene would have any unreasonable effects on populations of non-target terrestrial wildlife. Also, end-use naphthalene products would not be expected to reach the aquatic environment in significant amounts; thus fish and other aquatic organisms will most probably not be seriously affected under the current fumigation and repellent use patterns. It should be noted that naphthalene is also used as a repellent of pigeons, sparrows, squirrels and bats within dormers and eaves of buildings, however, this is not considered on outdoor use.

There is some information on the effects of naphthalene vapors on ornamental plants. Species such as Calendula officinalis, Centaurea imperialis, Cyclamen indicum, Fuchsia speciosa, Callistephus chinensis (China aster), Physalis fracnheti , rose seedlings and geranium were not adversely affected when exposed to naphthalene vapors at 13% saturation in a greenhouse. Based on the current minor outdoor use patterns, it is unlikely that non-target plants would be exposed to hazardous concentrations of naphthalene vapors in the field.

Due to the limited acceptable information available, a detailed hazard assessment for technical (manufacturing-use) or end-use products of naphthalene cannot be made for non-target animal and plant species.

C. Summary of Data Gaps

Six basic studies are generally required when a pesticide has outdoor uses. Given the extremely small exposure expected to fish and wildlife resulting from the use patterns of naphthalene, the bluegill 96 LC_{50} and the upland game species LC_{50} requirements can be waived. The following four studies will still be required:

1) The Avian Single Dose Oral LD_{50} . This study should be performed on either an upland avian species (preferably bobwhite quail or ring-necked pheasant) or a wild waterfowl species (preferably the mallard duck);

2) The Avian Dietary LC_{50} . One eight-day dietary LC_{50} study is required. The study should be performed on a mallard duck.

3) Fish Acute Toxicity . One 96-hour LC_{50} study should be performed. The study should use a coldwater fish species (preferably rainbow trout) and;

4) Acute Toxicity to Aquatic Invertebrates. One 48-hour LC_{50} study should be performed. The preferred species for this study is Daphnia magna.

IX. Efficacy

A. Efficacy Profile

The review of naphthalene data and the identification of data gaps are limited to efficacy data only as it relates to public health applications. The Agency has provided for the waiver of efficacy data submission as a part of the registration process in all other instances (44 FR 27932; May 11, 1979).

Supportive efficacy information will be required for products intended for use inside premises to repel pests of public health significance such as bats and birds.

According to Marsh and Howard (1977, MRID #GS0022030), there are no known studies or "good information" as of the date of this Registration Standard (September 1981) which addresses the topic of naphthalene's efficacy as a bat or bird repellent in public health uses. Due to the lack of experimental data on the subject, the efficacy of naphthalene could not be determined. However, all information reported regarding the efficacy of naphthalene has been assessed, based primarily on statements made by authors in published articles.

B. Factors Influencing Efficacy

Several factors can affect the efficacy of naphthalene as a repellent. The concentration of naphthalene fumes in a treatment area seems to be the pivotal factor. A relatively confined treatment area, such as a fairly tight attic or a space between walls, greatly improves the chance of repelling birds and bats from these areas. The reduced ventilation of the repellent fumes allows the concentration of the fumes to build up in these areas, (Constantine, 1979, GS0022028; Marsh and Howard, 1977, GS0022030; Clark 1975, GS0022026. Also, the amount of naphthalene actually applied to a treatment area directly affects the concentration of the repellent fumes in the area.

C. Use Sites

1. Attics; Wall Voids

The articles reviewed by the Agency on the efficacy of naphthalene agree on one point. The efficacy of naphthalene to control bats which are considered public health problems is contingent upon the repellent being applied in enclosed spaces such as attics and wall voids.

2. Target Pests

Pests currently on federally-registered naphthalene labels are often listed in general terms. The terms "birds" and "bats" are used along with some specific bird names (i.e., pigeons, starlings, and sparrows). Since naphthalene is used as a repellent, which implies lack of toxicity to target pests, and since articles reviewed by the Agency seem to indicate that the repellency of naphthalene for public health uses does not vary significantly between species of birds or bats, the Agency believes that the general terms "bats" and "birds" are acceptable for these products.

a. Bats (Chiroptera)

Because bats leave their roosts at night, they are less resistant to being repelled by naphthalene as night time nears. Conversely, it is harder to repel bats from a roost during the day and, therefore, this could require a higher concentration of naphthalene fumes to do so. Bats' olfactory senses are developed sufficiently to enable them to smell naphthalene, although the primary mode of repellent action appears to be its irritation of the bats' mucous membranes. Dosage recommendations in the literature range from 2 to 5 pounds of naphthalene for the "average" bat roost in dwellings (Constantine, 1979, GS0022028; Marsh and Howard, 1977, GS0022030; Silver, 1935, GS0022034), to 5 pounds of naphthalene per 2000 cubic feet of enclosed space (Clark 1975, GS0022026).

b. Birds, including Pigeon (Columba livia), Starling (Sturnus vulgaris), and Sparrow (Passer domesticus)

Although no specific dosage information was found in the literature, current label instruction recommend using 8 oz. of naphthalene for every 200 cu. ft. to repel birds.

Due to the scarcity of pertinent information, claims of efficacy for the bird repellent uses are not unequivocally supported by the currently available literature.

D. Summary of Data Gaps

The reviewed literature supports general claims of repellency for public health related uses of naphthalene. The existing information does not support claims relating to the length of the initiatory period (the period between application of the pesticide and manifestation of its efficacy) or claims relating to the duration of effectiveness of naphthalene products.

If these claims are not currently on the product labels then registrants will not be required to submit data supporting the claims. In order to keep the aforementioned claims on an existing label or to add such claims to a label, these data will be required, (see table III.C-2).

X. Confidential Annex

Persons wishing to read the contents of this annex, which contains Confidential Business Information, are requested to contact the United States Environmental Protection Agency for further details.

XI. Bibliography

A. Guide to Use of This Bibliography

1. Content of Bibliography

This bibliography contains citations of all the studies reviewed by EPA in arriving at the positions and conclusions stated elsewhere in this standard. The bibliography is divided into 3 sections: 1) citations that contributed information useful to the review of the chemical and considered to be part of the data base supporting registrations under the standard; 2) citations examined and judged to be inappropriate for use in developing the standard; and 3) standard reference material. Primary sources for studies in this bibliography have been the body of data submitted to EPA and its predecessor agencies in support of past regulatory decisions, and the published technical literature.

2. Units of Entry

The unit of entry in this bibliography is called a "study". In the case of published materials, this corresponds closely to an article. In the case of unpublished materials submitted to the Agency, the Agency has sought to identify documents at a level parallel to a published article from within the typically larger volumes in which they were submitted. The resulting "studies" generally have a distinct title (or at least a single subject), can stand alone for purposes of review, and can be described with a conventional bibliographic citation. The Agency has attempted also to unite basic documents and commentaries upon them, treating them as a single study.

3. Identification of Entries

The entries in this bibliography are sorted by author, date of the document, and title. Each entry bears, to the left of the citation proper, an nine-digit identifier. This number is unique to the citation, and should be used at any time specific reference is required. This number is called the "Master Record Identifier", or "MRID". It is not related to the six-digit "Accession Number" which has been used to identify volumes of submitted data; see paragraph 4(d(4) below for a further explanation.

4. Form of the Entry

In addition to the Master Record Identifier (MRID), each entry consists of a bibliographic citation containing standard elements followed, in the case of materials submitted to EPA, by a description of the earliest known submission. The bibliographic conventions used reflect the standards for the American National Standards Institute (ANSI), expanded to provide for certain special needs. Some explanatory notes of specific elements follow:

a. Author

Whenever the Agency could confidently identify one, the Agency has chosen to show a personal author. When no individual was identified, the Agency has shown an identifiable laboratory or testing facility as author. As a last resort, the Agency has shown the first known submitter as author.

b. Document Date

When the date appears as four digits with no question marks, the Agency took it directly from the document. When a four-digit date is followed by a question mark, the bibliographer deduced the date from evidence in the document. When the date appears as (19??), the Agency was unable to determine or estimate the date of the document.

c. Title

This is the third element in the citation. In some cases it has been necessary for the Agency bibliographers to create or enhance a document title. Any such editorial insertions are contained between square brackets.

d. Trailing Parenthesis

For studies submitted to us in the past, the trailing parenthesis include (in addition to any self-explanatory known submission.

1) Submission Date . Immediately following the word 'received' appears the date of the earliest known submission.

2) Administrative Number . The next element, immediately following the word 'under', is the registration number, experimental permit number, petition number, or other administrative number associated with the earliest known submission.

3) Submitter . The third element is the submitter, following the phrase 'submitted by'. When authorship is defaulted to the submitter, this element is omitted.

4) Volume Identification . The final element in the trailing parenthesis identifies the EPA accession number of the volume in which the original submission of the study appears. The six-digit accession number follows the symbol 'CDL', standing for "Company Data Library". This accession number is in turn followed by an alphabetic suffix which shows the relative position of the study within the volume. For example, within accession number 123456, the first study would be 123456-A; the second, 123456-B; the 26th, 123456-Z; and the 27th 123456-AA.

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Case GS0022 Naphthalene
Section 1
Citations Considered to be Part of the Data Base Supporting Registrations Under the Standard
Product Chemistry

005010379	Ballard, H.D., Jr. (1965) Naphthalene from petroleum. Advances in Petroleum Chemistry and Refining 10:219-273.
005008684	Liepins, R.; Mixon, F.; Hudak, C.; Parsons, T.B. (1977) Industrial Process Profiles for Environmental Use: Chapter 6. The Industrial Organic Chemicals Industry. Cincinnati, Ohio: U.S. Environmental Protection Agency, Industrial Environmental Research Laboratory. (Environmental protection technology series no. EPA-600/2-77-023f; available from: NTIS, Springfield, VA; PB-281 478)
005010941	Martin, H.; Miles, J.R.W. (1953) Guide to the Chemicals Used in Crop Protection. 2nd ed. Ottawa, Ontario, Canada: Canada Department of Agriculture.
000004900	Nowak, L.M. (1975) Interim Material Safety Data Sheet for Naphthalene. (Unpublished study received May 6, 1977 under unknown admin. no.; prepared by Ashland Oil, Inc., submitted by Kenova Chemical Co., St. Louis, Mo.; CDL:229765-A)

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Case GS0022 Naphthalene
Section 1
Citations Considered to be Part of the Data Base Supporting
Registrations Under the Standard

Environmental Fate

005017183 Bramson, L.M. (1960) K voprosam ob isparyaemosti naphtalina i ego predelno dopustimoi concentracii. [The volatility of naphthalene and its maximum permissible concentration in the atmosphere of industrial premises.] Gigiena Truda i Professional'nye Zabolevaniya. [Labor Hygiene and Occupational Diseases.] 4(6):50-52.

005005354 Cerniglia, C.E.; Gibson, D.T. (1977) Metabolism of naphthalene by *Cunninghamella elegans*. Applied and Environmental Microbiology 34(4):363-370.

005005353 Cerniglia, C.E.; Gibson, D.T. (1978) Metabolism of naphthalene by cell extracts of *Cunninghamella elegans* . Archives of Biochemistry and Biophysics 186(1):121-127.

005005937 Cerniglia, C.E.; Hebert, R.L.; Szaniszlo, P.J.; Gibson, D.T. (1978) Fungal transformation of naphthalene. Archives of Microbiology 117(2):135-143.

005007776 Cundell, A.M.; Traxler, R.W. (1973) Microbial degradation of petroleum at low temperature. Marine Pollution Bulletin 4(8):125-127.

005012107 Cundell, A.M.; Traxler, R.W. (1973) The isolation and characterization of hydrocarbon-utilizing bacteria from Chedabucto Bay, Nova Scotia. Pages 421-426, In Proceedings of Joint Conference on Prevention and Control of Oil Spills; Mar 13-15, Washington, D.C. Washington, D.C.: American Petroleum Institute.

005008688 Cundell, A.M.; Traxler, R.W. (1976) Psychrophilic hydrocarbon-degrading bacteria from Narragansett Bay, Rhode Island, U.S.A. Material und Organismen 11(1):1-17.

005019904 Hansen, N.; Jensen, V.B.; Appelquist, H.; Morch, E. (1978) The uptake and release of petroleum hydrocarbons by the marine mussel *Mytilus edulis*. Progress in Water Technology 10(5/6):351-359.

005014797 Kaneko, Y.; Saino, Y.; Doi, S. (1969) Biseibutsu ni yoru takan hokozoku tankasuiso no taisha ni kansuru kenkyu (Dainippo) S-210, 592 kin no fuenansuren taisha. [Studies on the metabolism of polynuclear aromatic hydrocarbons by microorganisms: II. Phenanthrene metabolism of strain S-210 and 592.] Nippon Nogei Kagaku Kaishi. [Journal of the Agricultural Chemical Society of Japan.] 43(1):21-27.

Environmental Fate Continued

005016326 Kvasnikov, E.I.; Tin'yanova, N.Z.; Krivitskii, I.P. (1970) Naftalinokyslyuyuchi bakteriyi zakhidnoukrayins'kykh naftorodovyshch. [Naphthalene-oxidizing bacteria of the western Ukrainian oil-bearing deposits.] Mikrobiologichnii Zhurnal (Kiev). [Journal of Microbiology.] 32(3):294-297.

005006779 Lee, R.F.; Gardner, W.S.; Anderson, J.W.; Blaylock, J.W.; Barwell-Clarke, J. (1978) Fate of polycyclic aromatic hydrocarbons in controlled ecosystem enclosures. Environmental Science and Technology 12(7):832-838.

005006197 Lonsane, B.K.; Barua, P.K.; Singh, H.D.; Mathur, R.K.; Baruah, J.N.; Iyengar, M.S. (1974) Formation of salicylic acid from naphthalene by microorganisms: Part I--Studies on isolation, characterization and growth of bacterial isolates utilizing naphthalene. Indian Journal of Experimental Biology 12(2):158-161.

005006198 Lonsane, B.K.; Vadalkar, K.; Singh, H.D.; Baruah, J.N. (1976) Hydrocarbon utilization by Brevibacterium, Azotomonas, Protaminobacterium, Mycococcus and Aeromonas spp. Indian Journal of Experimental Biology 14(6):734-736.

005015494 Lopatik, M.D. (1964) Izuchenie sposobnosti mikobakterii okislyat' uglevodorody. [Hydrocarbon-oxidizing capacity of mycobacteria.] Mikrobiologiya. [Microbiology.] XXXIII(2):236-238.

005005660 Mackay, D.; Wolkoff, A.W. (1973) Rate of evaporation of low-solubility contaminants from water bodies to atmosphere. Environmental Science and Technology 7(7):611-614.

005012039 Shtein, A.L.; Dumova, M.S.; Trondina, G.I. (1976) Issledovanie ravnovesiya naftalina, ammiaka i piridina pri malykh kontsentratsiyach mezhdu rodoi i rozduchom. [Equilibrium distribution of naphthalene, ammonia, and pyridine in low concentrations between water and air.] Zhurnal Prikladnoi Khimii. [Journal of Applied Chemistry.] 49(3):650-651.

005015998 Skryabin, G.K.; Starovoitov, I.I. (1975) An alternative pathway of naphthalene catabolism in Pseudomonas fluorescens. Doklady Biochemistry (English Translation) 221(1/6):141-143.

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Case GS0022 Naphthalene
Section 1
Citations Considered to be Part of the Data Base Supporting
Registrations Under the Standard
Environmental Fate Continued

005017304 Slavnina, G.P. (1970) Bakterii, ispol'zuyushchiye aromaticheskiye uglevodorodi. [Bacteria which utilize aromatic hydrocarbons.] Trudy, Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofiziki i Geokhimii. [Transactions, All-Union Scientific Research Institute of Nuclear Geophysics and Geochemistry.] (8):247-254.

005006598 Soto, C.; Hellebust, J.A.; Hutchinson, T.C. (1977) Effect of naphthalene and aqueous crude oil extracts on the green flagellate *Chlamydomonas angulosa*. III. Changes in cellular composition. Canadian Journal of Botany 55(22):2765-2777.

005018634 Southworth, G.R.; Beauchamp, J.J.; Schmieder, P.K. (1978) Bioaccumulation potential of polycyclic aromatic hydrocarbons in *Daphnia pulex*. Water Research 12(11):973-977.

005009267 Starovoitov, I.I.; Nefedova, M.Y.; Yakovlev, G.I.; Zyakun, A.M.; Adanin, V.M. (1975) Gentisic acid as a microbiological oxidation product of naphthalene. Bulletin of the Academy of Sciences of the USSR, Division of Chemical Science. A translation of: Izvestiya Akademii Nauk SSSR, Seriya Khimicheskaya 24(9):1974-1975.

005017184 Traxler, R.W. (1973) Bacterial degradation of petroleum materials in low temperature marine environments. Pages 163-170, *In* The Microbial Degradation of Oil Pollutants, Proceedings of a Workshop; Dec 4-6, 1972, Georgia State University, Atlanta, Georgia. Edited by D.G. Ahearn and S.P. Meyers. Baton Rouge, La.: Louisiana State University, Center for Wetland Resources. (Sea Grant publication no. LSU-SG-73-01; available from: NTIS, Springfield, VA; COM-74-11013)

005005371 Walker, J.D.; Colwell, R.R. (1976) Measuring the potential activity of hydrocarbon-degrading bacteria. Applied and Environmental Microbiology 31(2):189-197.

OFFICE OF PESTICIDE PROGAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Case GS0022 Naphthalene
Citations Considered to be Part of the Data Base Supporting Registrations Under the Standard
Toxicology

005015698 Adams, D.R. (1930) A study of the correlation between the biochemical and intra-ocular changes induced in rabbits by the administration of naphthalene. British Journal of Ophthalmology 14(11):545-576.

GS0022024 Battelle's Columbus Laboratories, Subcontract No. 76-34-106002, March 4, 1980. Subchronic Toxicity Studyz: Naphthalene (C52904) in Fischer 344 Rats.

GS0022023 Battelle's Columbus Laboratories, Subcontact No. 76-34-106002, March 4, 1980. Subchronic Toxicity Study: Naphthalene (C52904) in B6C3F1 Mice.

005006208 Boyland, E.; Sims, P. (1957) Metabolism of polycyclic compounds: 11. The conversion of naphthalene into 2-hydroxy-1-naphthyl sulphate in the rabbit. Biochemical Journal 66(1):38-40.

005006209 Boyland, E.; Sims, P. (1958) Metabolism of polycyclic compounds: 12. An acid-labile precursor of 1-naphthylmercapturic acid and naphthol: an N-acetyl-S-(1:2-dihydrohydroxynaphthyl)-L-cysteine. Biochemical Journal 68(3):440-447.

005006213 Boyland, E.; Wiltshire, G.H. (1953) Metabolism of polycyclic compounds: 7. The metabolism of naphthalene, 1-naphthol and 1:2-dihydroxy-1:2-dihydronaphthalene by animals. Biochemical Journal 53(4):636-641.

005020080 Chen, K.C.; Dorough, H.W. (1979) Glutathione and mercapturic acid conjugations in the metabolism of naphthalene and 1-naphtyl N-methylcarbamate (carbaryl). Drug and Chemical Toxicology 2(4):331-354.

005005368 Corner, E.D.S.; Billett, F.S.; Young, L. (1954) Biochemical studies of toxic agents: 6. The conversion of naphthalene into 1:2-dihydro-2-hydroxy-1-naphthyl glucosiduronic acid in the rabbit. Biochemical Journal 56(2):270-274.

005005367 Corner, E.D.S.; Young, L. (1954) Biochemical studies of toxic agents: 7. The metabolism of naphthalene in animals of different species. Biochemical Journal 58:647-655.

005019746 D'Asaro Biondo, M. (1933) L'azione dei vapori di naftalina sull'occhio (richerche sperimentali). [The action of naphthalene vapors on the eyes (experimental research).] Rassegna Italiana d'Ottalmologia. [Italian Review of Ophthalmology.] 2:762-773.

OFFICE OF PESTICIDE PROGAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Case GS0022 Naphthalene
Citations Considered to be Part of the Data Base Supporting
Registrations Under the Standard
Toxicology Continued

005005949 Mackell, J.V.; Rieders, F.; Brieger, H.; Bauer, E.L. (1951) Acute hemolytic anemia due to ingestion of naphthalene moth balls. Pediatrics 7:722-728.

005007954 Marsden, C.M.; Young, L. (1958) Biochemical studies of toxic agents: 10. Observations on the metabolism of 355 labelled mercapturic acids. Biochemical Journal 69(2):257-265.

005005197 Pirie, A. (1968) Pathology in the eye of the naphthalene-fed rabbit. Experimental Eye Research 7(3):354-357.

005012927 Prochorow, M.; Nowotarska, T. (1965) Cztery przypadki zatrucia naftalina niemowlat. [Four cases of naphthalene poisoning in infants.] Pediatria Polska. [Polish Pediatrics.] XL(9):999-1000.

005015285 Schmaehl, D. (1955) Pruefung von Naphthalin und Anthracen auf cancerogene Wirkung an Ratten. [Testing of naphthalene and anthracene for carcinogenic effect in rats.] Zeitschrift fuer Krebsforschung 60(6):697-710.

005005672 Stillwell, W.G.; Bouwsma, O.J.; Horning, M.G. (1978) Formation in vivo of deuterated methylthio metabolites of naphthalene from L-methionine (methyl-d_3). Research Communications in Chemical Pathology and Pharmacology 22(2):329-343.

005005671 Stillwell, W.G.; Bouwsma, O.J.; Thenot, J.P.; Horning, M.G.; Griffin, G.W.; Ishikawa, K.; Takaku, M. (1978) Methylthio metabolites of naphthalene excreted by the rat. Research Communications in Chemical Pathology and Pharmacology 20(3):509-530.

005005235 Zuelzer, W.W.; Apt, L. (1949) Acute hemolytic anemia due to naphthalene poisoning: a clinical and experimental study. Journal of the American Medical Association 141(3):185-190.

OFFICE OF PESTCIDE PROGAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Case GS0022 Naphthalene
Section 1
Citations Considered to be Part of the Data Base Supporting Registrations Under the Standard
Ecological Effects

005007545 Corner, E.D.S.; Harris, R.P.; Kilvington, C.C.; O'Hara, S.C.M. (1976) Petroleum compounds in the marine food web: short-term experiments on the fate of naphthalene in Calanus. Journal of the Marine Biological Association of the United Kingdom 56(1):121-133.

005009021 Harris, R.P.; Berdugo, V.; Corner, E.D.S.; Kilvington, C.C.; O'Hara, S.C.M. (1977) Factors affecting the retention of a petroleum hydrocarbon by marine planktonic copepods. Pages 286-304, In Fate and Effects of Petroleum Hydrocarbons in Marine Organisms and Ecosystems. Edited by D.A. Wolfe. Elmsford, N.Y.: Pergamon Press.

005006550 Harris, R.P.; Berdugo V.; O'Hara, S.C.M.; Corner, E.D.S. (1977) Accumulation of 14C-1-naphthalene by an oceanic and an estuarine copepod during long-term exposure to low-level concentrations. Marine Biology 42(3):187-195.

005007239 Hartzell, A.; Wilcoxon, F. (1930) Naphthalene fumigation at controlled concentrations. Journal of Economic Entomology 23:608-618.

005015700 Kofranek, A.M.; Markiewicz, L. (1967) Selected naphthalenes as disbudding agents for chrysanthemums: part 2 of a 2-part discussion. Florists' Review 140(3617):20-21,54-57.

005009023 Moutia, L.A.; Mamet, R. (1943) Experiments on the storage of maize seeds. Revue Agricole et Sucriere de l'Ile Maurice XXII(1):5-9.

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Case GS0022 Naphthalene
Section 1
Citations Considered To Be Part Of The Data Base Supporting
Registration Under The Standard

Efficacy

MRID	Citation
GS0022025	Anon. (1949). Bird Repellents. Pest Control 17(12):20.
GS0022026	Clark, D. O. (1975). Vertebrate Pest Control Handbook. Cal. Dept. of Food and Agri., Div. of Plant Industry; pp. 508-1.
GS0022028	Constantine, D. G. (1979). Rabies and Bat Management. Bull. Soc. Vector Ecol. 4:1-9.
GS0022029	Ebeling, W. (1975). Urban_Entomology. Univ. of Cal. Div. of Agri. Sci. pp. 603.
GS0022030	Marsh, R. E. Howard, W.E. (1977). Vertebrate Control Manual. Pest Control 45(10):34.
GS0022031	Murphy, K.T. (1975). Bat Problem Abated Temprarily. The Patriot Ledger. Wed., July 9, pp. 16.
GS0022032	Scott, H. G. (1961). Bats: Public Health Importance, Identification, and Control. Pest Control 29(8): 23-29.
GS0022033	Scott, H. G. (1961). Pigeons: Public Health Importance and Control. Pest Control 29(9):9 & 60-61.
GS0022034	Silver, J. (1935). Eliminate Bats from Buildings. USDA Leaflet 109:4-5.
005000993	British Crop Protection Council (1974) Pesticide Manual: Basic Information on the Chemicals Used as Active Components of Pesticides. Edited by H. Martin and C. R. Worthing. 4th ed. London, England: British Crop Protection Council.
GS0018006	Farm Chemicals Handbook (1979). Meister Publishing Co., Willoughly, OH. 44094

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Case GS0022 Naphthalene
Section 2
Citations Examined and Judged to be Inappropriate For Use in Developing the standard Registrations Under the Standard

005006685 Abbott, B.J.; Gerhardt, P. (1970) Dialysis fermentation. I. Enhanced production of salicylic acid from naphthalene by *Pseudomonas fluorescens*. Biotechnology and Bioengineering XII(4):577-589.

005015489 Abelson, S.M.; Henderson, A.T. (1951) Moth ball poisoning. U.S. Armed Forces Medical Journal 2(3):491-493.

005007969 Abraham, M.H.; Marks, R.E. (1964) Gas-liquid chromatography of some condensed-ring aromatic hydrocarbons on lightly-loaded columns. Journal of Chromatography 13(2):344-349.

005006870 Allen, J.G.; Malmberg, E.W., inventors; Sun Oil Co., assignee (1966) Preparation of naphthalene and certain dimethylnaphthalenes. U.S. patent 3,235,615. Feb 15. 5 p. Cl. 260-668.

005009966 Ambrose, D.; Lawrenson, I.J.; Sprake, C.H.S. (1975) The vapour pressure of naphthalene. Journal of Chemical Thermodynamics 7(12):1173-1176.

005007369 American Cyanamid Co., assignee (1961) Method of purifying naphthalene. British patent specification 883,042. Nov 22. 4 p. Int. Cl. C 07c.

005006119 Anderson, J.A., Jr. (1948) Determination of naphthalene, methyl naphthalenes, and total naphthalenes in admixture with other hydrocarbons by ultraviolet absorption. Proceedings of the American Petroleum Institute, Section III: Refining 28:81-84.

005006871 Anderson, J.A., Jr.; Hoffmann, E.J., inventors; Esso Research and Engineering Co., assignee (1956) Production of naphthalene. U.S. patent 2,729,688. Jan 3. 3 p. Cl. 260-668.

005007447 Andrews, D.H.; Lynn, G.; Johnston, J. (1926) The heat capacities and heat of crystallization of some isomeric aromatic compounds. Journal of the American Chemical Society 48:1274-1287.

005008559 Angus, J.G.; Christ, B.J.; Morris, G.C. (1968) Absorption spectra in the vacuum ultraviolet and the ionization potentials of naphthalene and naphthalene-d ??? molecules. Australian Journal of Chemistry 21(9):2153-2159.

005006964 Anon. (1918) The solubility of naphthaline in ammonia. Gas Age 41:28-30.

005015352 Anon. (1960) Now: naphthalene from petroleum. Oil in Canada 13(3):31-34.

005008034 Anon. (1961) New thermal process makes cheaper benzene. Oil and Gas Journal 59:80-81.

005011495 Antheaume, J.; Guiochon, G. (1965) Application de la chromatographie en phase gazeuse a l'etude de la composition des fractions moyennes d'un brut petrolier. [Application of gas chromatography to the investigation of the composition of medium fractions of a crude petroleum.] Bulletin de la Societe Chimique de France (2):298-307.

005007551 Anthes, J.F. (1930) An investigation of the Walters Method for the determination of naphthalene. Pages 1148-1162,* In Proceeding--American Gas Association. Vol. 12. New York: American Gas Association.

005005953 Anziulewicz, J.A.; Dick, H.J.; Chiarulli, E.E. (1959) Transplacental naphthalene poisoning. American Journal of Obstetrics and Gynecology 78(3):519-521.

005006873 Apgar, F.A., inventor; Sinclair Refining Co., assignee (1955) Naphthalene purification by washing with a surface active agent. U.S. patent 2,704,779. Mar 22. 4 p. Cl. 260-674.

005009183 Armstrong, W.E.; Densham, A.B.; Griffith, R.H., inventors; Gas Light and Coke Co., assignee (1951) Improvements in or relating to the purification of naphthalene. British patent specification 651,154. Mar 14. 3 p.

005012274 Ashland Oil and Refining Co., assignee (1962) Improvements in or relating to the recovery of naphthalene from petroleum fractions. British patent specification 889,789. Feb 21. 9 p. Int. Cl. C 07c.

005006697 Asselin, G.F.; Erickson, R.A. (1962) Benzene and naphthalene from petroleum by the Hydeal process. Chemical Engineering Progress 58(4):47-52.

005006864 Asselin, G.F.; Erickson, R.A. (1962) Dealkylation puts petroleum industry into the benzene-naphthalene business. Oil and Gas Journal 60:127-129.

000009181 Atkins, E.L., Jr.; Anderson, L.D.; Greywood, E.A. (1969) Effect of Pesticides on Apiculture: Project No. 1499. (Unpublished study received Jul 29, 1976 under 352-342; prepared by Univ. of California--Riverside, Dept. of Entomology, submitted by E.I. du Pont de Nemours & Co., Wilmington, Del.; CDL:224800-C)

005008027 Ayyangar, G.N.R.; Vijayaraghavan, C. (1927) Germination tests on millet seeds. Pages 14-20, In Madras Agriculture Department Yearbook 1926.

005015761 Azoulay, E. (1966) Regulation de la biosynthese et de l'activite des catechol-oxygenases chez *Pseudomonas*. [Regulation of the biosynthesis and activity of catechol oxygenases in *Pseudomonas*.] Bulletin de la Societe Francaise de Physiologie Vegetale 12(2):111-121.

005006059 Backlund, P.S., inventor; Union Oil Co. of California, assignee (1964) Separation of naphthalenic from non-naphthalenic hydrocarbons. U.S. patent 3,132,078. May 5. 7 p. Cl. 202-42

005006061 Backlund, P.S., inventor; Union Oil Co. of California, assignee (1965) Recovery of petroleum naphthalene. U.S. patent 3,197,524. July 27. 5 p. Cl. 260-674.

005009259 Badger, G.M.; Donnelly, J.K.; Spotswood, T.M. (1963) The formation of aromatic hydrocarbons at high temperatures: XVII. The pyrolysis of a petrol. Australian Journal of Chemistry 16:392-400.

005013252 Badger, G.M.; Kimber, R.W.L. (1960) The formation of aromatic hydrocarbons at high temperatures. Part VII. The pyrolysis of indene. Journal of the Chemical Society 1960:2746-2749.

005016013 Bandow, F. (1951) Untersuchungen ueber die Spektren einiger polycyclischer Kohlenwasserstoffe. [Studies on the spectra of some polycyclic hydrocarbons.] Zeitschrift fuer Physikalische Chemie (Leipzig) 196(5/6):329-341.

005006676 Barbor, R.P. (1962) Naphthalene from catalytic gas oil. Oil and Gas Journal 60(21):123-125.

005015362 Barca-Galateanu, D. (1936) Das ultrarote Absorptionsspektrum des Naphtalindampfes. [Infrared absorption spectrum of naphthalene vapor.] Bulletin de la Societe Roumaine de Physique 37:19-34.

005006240 Barnsley, E.A. (1976) Naphthalene metabolism by pseudomonads: the oxidation of 1,2-dihydroxynaphthalene to 2-hydroxychromene-2-carboxylic acid and the formation of 2'-hydroxybenzalpyuvate. Biochemical and Biophysical Research Communication 72(3):1116-1121.

005006674 Barnsley, E.A. (1976) Role and regulation of the *ortho* and *meta* pathways of catechol metabolism in pseudomonads metabolizing naphthalene and salicylate. Journal of Bacteriology 125(2):404-408.

005008098 Barskii, V.D.; Bednov, V.M.; Aksenina, A.A. (1968) Optimising the formaldehyde refining of naphthalene under commercial conditions. Coke and Chemistry USSR. A translation of: Koks i Khimiya. (12):38-42.

005010618 Bazhulin, P.A.; Rakhimov, A.A. (1967) Investigation of the long-wavelength infrared absorption spectra of naphthalene, diphenyl, and p-dichlorobenzene. Soviet Physics--Solid State. A translation of: Fizika Tverdogo Tela 8(7):1719-1722.

005006109 Beale, R.N.; Roe, E.M.F. (1951) Ultra-violet absorption spectra of some metabolites of naphthalene, anthracene, and phenanthrene. Journal of the Chemical Society 1951(11):2884-2888.

005009061 Bernat, R.; Bombicki, K. (1968) Changes in the concentration of glutathione, ascorbic acid and amino acids with sulfhydryl groups in experimental cataract. Acta Physiologica Polonica XIX(2):197-204.

005008897 Bernstein, H.J.; Schneider, W.G. (1956) Nuclear magnetic resonance spectra of conjugated aromatic hydrocarbons [letter]. Journal of Chemical Physics 24(2):468-469.

005009967 Best, G.R.; Nabholz, J.V.; Ojasti, J.; Crossley, D.A., Jr. (1978) Response of microarthropod populations to naphthalene in three contrasting habitats. Pedobiologia 18(3):189-201.

005013259 Bhattacharyya, K.K.; Desikan, P. (1966) Production of basic aromatics by dealkylation of alkylaromatics. Petroleum and Hydrocarbons 1(3):369-377.

005013260 Binnington, D.S.; Geddes, W.F. (1934) Determination of naphthalene in poultry lice powders. Industrial and Engineering Chemistry, Analytical Edition 6(6):461-463.

005007371 Blacet, F.E.; Leighton, P.A.; Bartlett, E.P. (1931) The specific heats of five pure organic liquids and of ethyl alcohol-water mixtures. Journal of Physical Chemistry 35:1935-1943.

005007485 Bohon, R.L.; Claussen, W.F. (1951) The solubility of aromatic hydrocarbons in water. Journal of the American Chemical Society 73:1571-1578.

005016002 Bonino, G.B. (1937) Sulla costituzione molecolare della naftalina (commenti ad una nota del Prof. Giuseppe Oddo). [The molecular constitution of naphthalene (comments on a report by Professor Giuseppe Oddo).] Gazzetta Chimica Italiana LXVII:343-346.

005010852 Bornmann, J.A. (1962) Semiconductivity of naphthalene [letter]. Journal of Chemical Physics 36:1691-1692.

005012925 Boronin, A.M.; Borisoglebskaya, A.N.; Starovoitov, I.I. (1977) Mutanty plazmidy NPL-1, kontroliruynshchei okislenie naftalina.

005007549 Boronin, A.M.; Starovoitov, I.I.; Borisoglebskaya, A.N.; Skryabin, G.K. (1976) Plasmid of *Pseudomonas putida* which controls initial stages of naphthalene oxidation. Doklady Biological Sciences 228(4):226-228.

005005658 Bosmajian, G., Jr.; Ballard, H.D., Jr., inventors; Sinclair Refining Co., assignee (1958) Process for making naphthalene. U.S. patent 2,858,348. Oct 28. 5 p. Cl. 260-668.

005006649 Boyd, J.H., Jr., inventor; Atlantic Refining Co., assignee (1939) Purification of crystallizable derivatives of coal tar. U.S. patent 2,163,581. Jun 27. 9 p. Cl. 196-1.

005006062 Bozich, S.; Lewis, E.W.; Smith, B.D., inventors; Esso Research and Engineering Co., assignee (1959) Process for recovery of crystallizable hydrocarbons from crystalline slurries in stages. U.S. patent 2,913,503. Nov 17. 6 p. Cl. 260-666.

005006204 Braude, E.A. (1950) Studies in light absorption. Part IX. The relation between absorption intensities and molecular dimensions, and its application to the electronic spectra of polyenes and polycyclic benzenoid hydrocarbons. Journal of the Chemical Society 1950:379-384.

005006104 Bree, A.; Kydd, R.A. (1970) Vibrational spectra and assignment of naphthalene-d. Spectrochimica Acta, Part A 26(8):1791-1803.

005006662 Briggs, D.K.H.; Waddington, W.; McNeil, D. (1960) Batch fractionation of coal tar naphthalene oils. Industrial and Engineering Chemistry 52(2):145-146.

005007453 Brolin, S.E. (1950) Spectrophotometric investigations on the fluorescence of the eye lens in rats given naphthalin. Acta Ophthalmologica 28(II):163-177.

GS0022020 Brooks, P. and Lawley, P.D. Evidence for the binding of polynuclear aromatic hydrocarbons to nucleic acids of mouse skin: relation between carcinogen power of hydrocarbons and their binding to deoxyribonucleic acid; Nature, Vol. 202, 781-784, May 23, 1964.

005011487 Broude, V.L.; Umarov, L.M. (1975) Interpretatsiya IK spektra kristalla naftalina v oblasti valentnykh kolevanii C-H-svyazei 3000-3100 cm-1*. [Interpretation of the ir spectrum of naphthalene crystal in the 3000-3100-cm-1* region of the C-H stretching vibrations.] Optika i Spektroskopiya. [Optics and Spectroscopy.] XXXIX(1):68-74.

005006828 Brown, R.L.; Berger, H.G. (1924) Effects of indene on naphthalene determinations by picric acid. Industrial and Engineering Chemistry 16(9):917-921.

005005612 Bullard, R.W.; Holguin, G. (1977) Volatile components of unprocessed rice (*Oryza sativa* L.). Journal of Agricultural and Food Chemistry 25(1):99-103.

005006202 Burdett, R.A.; Gordon, B.E. (1947) Polarographic determination of naphthalenes in petroleum fractions. Analytical Chemistry 19(11):843-846.

005014811 Cahnmann, H.J.; Kuratsune, M. (1956) Polynuclear aromatic hydrocarbons in oysters collected in polluted water [abstract]. Pages 99-99, In Proceedings of the American Association for Cancer Resarch. Vol. 2. New York: Memorial Sloan-Kettering Cancer Center.

005007573 Calcott, W.S.; English, F.L.; Downing, F.B. (1924) Analysis of naphthalenesulfonic acids and naphthalene. Industrial and Engineering Chemistry 16(1):27-30.

005005362 Calder, J.A.; Lader, J.H. (1976) Effect of dissolved aromatic hydrocarbons on the growth of marine bacteria in batch culture. Applied and Environmental Microbiology 32(1):95-101.

005009022 Caldwell, R.S.; Caldarone, E.M.; Mallon, M.H. (1977) Effects of a seawater-soluble fraction of Cook Inlet crude oil and its major aromatic components on larval stages of the Dungeness crab, *Cancer magister* Dana. Pages 210-220, In Fate and Effects of Petroleum Hydrocarbons in Marine Organisms and Ecosystems. Edited by D.A. Wolfe. Elmsford, N.Y.: Pergamon Press.

005012280 Calkins, J.R., inventor; Sun Oil Co., assignee (1964) Improvements in or relating to the hydrogenation of hydrocarbons. British patent specification 974,282. Nov 4. 6 p. Int. Cl. C 07c.

005012281 Calkins, J.R., inventor; Sun Oil Co., assignee (1964) Preparation of naphthalene. British patent specification 965,872. Aug 6. 5 p. Int. Cl. C 07c; C 10g.

005012636 Camin, D.L.; Rossini, F.D. (1955) Physical properties of 14 American Petroleum Institute Research hydrocarbons, C to C*15

005006131 Cannon, C.G.; Sutherland, G.B.B.M. (1951) The infra-red absorption spectra of some aromatic compounds. Spectrochimica Acta 4:373-395.

005007663 Catterall, F.A.; Murray, K.; Williams, P.A. (1971) The configuration of the 1,2-dihydroxy-1,2-dihydronaphthalene formed in the bacterial metabolism of naphthalene. Biochimica et Biophysica Acta 237(2):361-364.

005009269 Catterall, F.A.; Williams, P.A. (1971) Properties of the naphthalene oxygenase from*Pseudomonas sp. NCIB 9816. Journal of General Microbiology 67(1):117-124.

005005355 Catterall, F.A.; Williams, P.A. (1972) A comparison of some properties of the 1,2-dihydroxynaphthalene oxygenase and catechol 2,3-oxygenase activities in naphthalene-grown Pseudomonas sp. N.C.I.B. 9816. Biochemical Journal 128(3):88-89.

005010984 Cerniglia, C.E.; Gibson, D.T.; Van Baalen, C. (1979) Algal oxidation of aromatic hydrocarbons: formation of 1-naphthol from naphthalene by Agmenellum quadruplicatum, strain PR-6. Biochemical and Biophysical Research Communications 88(1):50-58.

005008820 Cetorelli, J.J.; McCarthy, W.J.; Winefordner, J.D. (1968) The selection of optimum conditions for spectrochemical methods: IV. Sensitivity of absorption, fluorescence, and phosphorescence spectrometry in the condensed phase. Journal of Chemical Education 45(2):98-102.

005007566 Ch'in, N.C.H.; Baral, W.J., inventors; Union Oil Co. of California, assignee (1966) Manufacture of naphthalene. U.S. patent 3,227,769. Jan 4. 6 p. Cl. 260-672.

005006714 Chambers, J.M.; Robinson, H.D., Jr., inventors; Stone & Webster Engineering Corp., assignee (1963) Purification of naphthalene by distillation. U.S. patent 3,075,890. Jan 29. 6 p. Cl. 202-39.5.

005010774 Chang, W. (1969) Solubilities of biphenyl, naphthalene, perfluorobiphenyl, perfluoronaphthalene and hexachloroethane in nonelectrolytes. Dissertation Abstracts International B 32(11):6321.

005007263 Chopey, N.P. (1961) First petrochemical naphthalene. Chemical Engineering 68(9):70-73.

005009077 Chortyk, O.T.; Schlotzhauer, W.S.; Stedman, R.L. (1965) Lithium chloride as a gas chromatographic substrate for polynuclear aromatic hydrocarbons. Journal of Gas Chromatography 3(11):394-395.

005017431 Chusid, E.; Fried, C.T. (1955) Acute hemolytic anemia due to naphthalene ingestion. AMA American Journal of Diseases of Children 89:612-614.

005010519 Coffey, J.C.; Ward, C.H.; King, J.M. (1976) Effects of petroleums on the growth of freshwater algae. Pages 885-893, In Industrial Waste Conference, 31st; May 4-6, Purdue University, Lafayette, Indiana. Lafayette, Ind.: Purdue University.

005005360 Coggeshall, N.D.; Glessner, A.S., Jr. (1949) Ultraviolet absorption analysis for naphthalenes. Analytical Chemistry 21(5):550-553.

005016966 Cook, J.W.; Loudon, J.D.; Williamson, W.F. (1950) Stereochemistry of metabolic diols from naphthalene and anthracene. Journal of the Chemical Society (3):911-914.

005009255 Cook, J.W.; Schoental, R.; Scott, E.J.Y. (1950) Relation between bond structure and the longest ultra-violet absorption band of polycyclic aromatic hydrocarbons. Proceedings of the Physical Society, London 63A:592-598.

005007442 Daglish, C. (1950) The ultraviolet absorption spectra of some hydroxynaphthalenes. Journal of the American Chemical Society 72:4859-4864.

005005404 Davies, J.I.; Evans, W.C. (1964) Oxidative metabolism of naphthalene by soil pseudomonads: the ring-fission mechanism. Biochemical Journal 91(2):251-261.

005020249 Davies, J.S.; Westlake, D.W.S. (1979) Crude oil utilization by fungi. Canadian Journal of Microbiology 25(2):146-156.

005009037 Dawson, J.P.; Thayer, W.W.; Desforges, J.F. (1958) Acute hemolytic anemia in the newborn infant due to naphthalene poisoning: report of two cases, with investigation into the mechanism of the disease. Blood XIII(12):1113-1125.

005005745 Day, A.D.; Thompson, R.K. (1965) Some effects of paradichlorobenzene, naphthalene, DDT and Ceresan on the germination of field crop seeds. Agronomy Journal 57(4):321-322.

005008044 Dean-Raymond, D.; Bartha, R. (1975) Biodegradation of Some Polynuclear Aromatic Petroleum Components by Marine Bacteria. Arlington, Va.: Office of Naval Research. (Available from; NTIS, Springfield, VA: AD/A-006 346; Office of Naval Research technical report no. 5)

005008079 Densham, A.B.; Gough, G.; Griffith, R.H., inventors; North Thames Gas Board, assignee (1955) Improvements in or relating to the purification of aromatic hydrocarbons. British patent specification 735,706. Aug 24. 6 p.

005008132 Derby, I.H.; Davis, K.R., inventors; Peter C. Reilly, assignee (1929) Method of purification of hydrocarbons. U.S. patent 1,727,052. Sep 3. 3 p.

005011116 Dewar, M.J.S.; Longuet-Higgins, H.C. (1954) The electronic spectra of aromatic molecules. I: Benzenoid hydrocarbons. Proceedings of the Physical Society, London, Section A 67:795-804.

005014802 Dimitrov, D.; M'lchanov, D. (1960) Ostro naftalinovo otravyane.

005008817 Dodge, B.F. (1922) Calculation of vapor pressures of naphthalene, anthracene, phenanthrene, and anthraquinone by Duehring's relation [letter]. Journal of Industrial and Engineering Chemistry 14(6):569-570.

005005674 Duckett, J.A.; Smithson, T.L.; Wieser, H. (1978) The vapour phase far-infrared spectra of naphthalene- h and-* d Journal of Molecular Structure 44(1):97-99.

005005673 Dunn, N.W.; Gunsalus, I.C. (1973) Transmissible plasmid coding early enzymes of naphthalene oxidation in *Pseudomonas putida*. Journal of Bacteriology 114(3):974-979.

005011498 Eckhardt, F.; Heinze, H.O. (1961) Vergleich konventioneller Untersuchungsverfahren fuer Kohlenwertstoffe mit der gaschromatographischen und spektroskopischen Analyse.

005007448 Edwards, R.E., Jr.; Pflasterer, J.L.; Smeaton, R.M., inventors; United States Steel Corp., assignee (1961) Method of recovering high-purity naphthalene. U.S. patent 2,990,435. Jun 27. 2 p. Cl. 260-674.

005008569 Eganhouse, R.P.; Calder, J.A. (1976) The solubility of medium molecular weight aromatic hydrocarbons and the effects of hydrocarbon co-solutes and salinity. Geochimica et Cosmochimica Acta 40(5):555-561.

005011323 Eisenbrand, J. (1971) Ueber die Wasserloeslichkeit des 3,4-Benzpyrens und anderer aromatischer Kohlenwasserstoffe und ihre Erhoehung durch Loesungsvermittler. [Water solubility of 3,4-benzopyrene and other aromatic hydrocarbons and its increase by solubilizers.] Deutsche Lebensmittel-Rundschau 67(12):435-444.

005015364 Ekkert, L. (1931) Beitrag zu den Farbenreaktionen des Benzols, Naphthalins, Anthrazens, Phenanthrens, Chinons, Anthrachinons und Chinolins. [Contribution to the color reactions of benzene, naphthalene, anthracene, phenanthrene, quinone, anthraquinone and quinoline.] Pharmazeutische Zentralhalle fuer Deutschland 72(7):51-53.

005009188 Eley, D.D.; Fawcett, A.S.; Willis, M.R. (1968) Semiconductivity of organic substances: Part 12.--Electrode injection of charge carriers into crystals of small aromatic molecules. Transactions of the Faraday Society 64(6):1513-1527.

005006696 Emery, E.M.; Gasser, G.M., inventors; Monsanto Co., assignee (1971) Naphthalene analysis method. U.S. patent 3,559,376. Feb 2. 10 p. Int. Cl. B 01d 15/08; Cl. 55-67.

005007375 Emmerson, H.R.; Lafferty, J.L.; Stiles, V.E.; Backlund, P.S.; Doumani, T.F. (1963) Unidak--an improved naphthalene process. Oil and Gas Journal 61(22):123-126,129.

005006121 Emmerson, H.R., inventor; Union Oil Co. of California, assignee (1965) Manufacture of naphthalene. U.S. patent 3,193,594. Jul 6. 8 p. Cl. 260-672.

005006699 Eppley, M. (1928) A formula for calculating the boiling-points of naphthalene corresponding to pressures between 824 millimeters and 704 millimeters of mercury: and the boiling-point of naphthalene at normal pressure. Journal of the Franklin Institute 205:383-394.

005005280 Epstein, A.K.; Harris, B.R. (1926) Detection of minute amounts of naphthalene in flour. Cereal Chemistry III:60-62.

005011486 Etat Francais represente par le Ministre de la Defense Nationale et de la Guerre, assignee (1963) Perfectionnements aux procedes pour la synthese du benzene et de ses homologues. [Improved procedures for the synthesis of benzene and of its homologues.] French brevet d'invention 1,329,521. Jun 12. 2 p. Int. Cl. C 07c.

005006874 Eubank, O.C., inventor; Union Oil Co. of California, assignee (1965) Manufacture of petroleum naphthalene. U.S. patent 3,193,592. Jul 6. 6 p. Cl. 260-672.

005008283 Fanburg, S.J. (1940) Exfoliative dermatitis due to naphthalene: report of an eruption resembling mycosis fungoides. Archives of Dermatology and Syphilology 42:53-58.

005008818 Ferguson, J.; Reeves, L.W.; Schneider, W.G. (1957) Vapor absorption spectra and oscillator strengths of naphthalene, anthracene, and pyrene. Canadian Journal of Chemistry 35:1117-1123.

005010167 Fernley, H.N.; Evans, W.C. (1958) Oxidative metabolism of polycyclic hydrocarbons by soil Pseudomonads . Nature 182(4632):373-375.

005006707 Findlay, R.A., inventor; Phillips Petroleum Co., assignee (1959) Crystal purification apparatus. U.S. patent 2,898,271. Aug 4. 6 p. Cl. 196-14.5.

005007557 Fishbein, L. (1976) Potential hazards of fumigant residues. Environmental Health Perspectives 14:39-45.

005007556 Fisher, G.S.; Legendre, M.G.; Lovgren, N.V.; Schuller, W.H.; Wells, J.A. (1979) Volatile constituents of southernpea seed

005005646 Flanders, R.L., inventor; California Research Corp., assignee (1964) Production of naphthalene. U.S. patent 3,151,176. Sep 29. 3 p. Cl. 260-673.5.

005010156 Fleming, W.E.; Baker, F.E. (1934) The Use of Naphthalene Against the Japanese Beetle. Washington, D.C.: U.S. Department of Agriculture. (USDA technical bulletin no. 427)

005005945 Flood, J.M. (1956) Contact dermatitis from naphthalene. Bulletin of the Guthrie Clinic 26(2):63-65.

005007541 Fowler, L.; Trump, W.N.; Vogler, C.E. (1968) Vapor pressure of naphthalene: new measurements between 40 degrees and 180 degrees C. Journal of Chemical and Engineering Data 13(2):209-210.

005006849 Fox, J.J.; Martin, A.E. (1939) Infra-red spectra in the 3 mu region of naphthalene, alpha- and beta-methylnaphthalenes, quinoline, and isoquinoline: an aid to analysis. Journal of the Chemical Society 1939:318-322.

005017944 Franck-Newmann, M.; Jossang, P. (1964) Emploi des complexes pi en chromatographie sur couche mince: derives polynitres aromatiques et hydrocarbures aromatiques a noyaux condenses.

005016576 Francois, M.; Seguin, L. (1928) Analyse des insecticides. Produits secs: naphtaline; naphtaline et camphre; poudres bleues a la strychnine; ble rouge. [Analysis of insecticides. Dry products: naphthalene; naphthalene and camphor; strychnine-base blue powders; red wheat.] Annales des Falsifications et des Fraudes 7:204-209.

005017948 Francois, M.; Seguin, L. (1929) Analyse des insecticides. Insecticides liquides non miscibles a l'eau: carbures melanges; tetrachlorure de carbone; nitrobenzine; naphtaline; salicyeate de methyle. [Analysis of insecticides. Liquid insecticides non-miscible with water: mixed hydrocarbons, carbon tetrachloride, nitrobenzene, naphthalene, methyl salicylate.] Annales des Falsifications et des Fraudes 22:226-232.

005010162 Freeman, D.E. (1961) The ultraviolet emission spectrum of naphthalene vapor. Journal of Molecular Spectroscopy 6:305-311.

005006851 Friedenberg, R.; Jannke, P.J. (1965) Proof of ultrapurity in zone-refined naphthalene. Analytica Chimica Acta 33(6):655-669.

005011107 Friedman, B.S.; Kovach, S.M. (1960) Two-stage process for production of naphthalene and high octane gasoline from cycle stock. Pages 17-27, In Proceedings of the Fifth World Petroleum Congress; Jun 1-5, 1959, New York. New York: Fifth World Petroleum Congress.

005016335 Fugassi, P.; Masciantonio, P.; Trammell, R. (1958) Photo-oxidation of polycyclic hydrocarbons [abstract no. 11]. Preprints, Division of Gas and Fuel Chemistry, American Chemical Society 1958(Sep):4.

005005229 George, G.A.; Morris, G.C. (1968) The intensity of absorption of naphthalene from 30 000 cm. Molecular Spectroscopy 26(1):67-71.

005010502 Gesellschaft fuer Teerverwertung m.b.H., assignee (1962) Process for recovering naphthalene with a solidification point above 78 degrees C. from tar oil fractions. British patent specification 913,850. Dec 28. 4 p. Int. Cl. C 07c.

005006715 Gifford, H., Jr. (1932) Determination of the oxidation-reduction mechanism in the lens of rabbits with naphthalene cataract. Archives of Ophthalmology 7(5):763-768.

005007680 Gilbert, G.; Weil, R.C.; Hunter, R.H. (1961) Hydrorefining coal-tar naphthalene. Industrial and Engineering Chemistry 53(12):993-996.

005011616 Ginet, G.A.; Sechkarev, A.V. (1974) Proyavlenie defektnosti struktury v infrakrasnom spektre kristallicheskogo naftalina.

005014860 Golczyk, A. (1960) Dwa przypadki niedokrwistosci hemolitycznej po zatruciu naftalina. [Two cases of hemolytic anemia after naphthalene poisoning.] Polski Tygodnik Lekarski. [Polish Medical Weekly.] 15(22):837-839.

005012041 Graham, E.L.; Zacharias, W.C., inventors; Dow Chemical Co., assignee (1958) Verfahren zur Herstellung von Kohlenwasserstoffen, einschliesslich Aethylen, Acetylen und Benzol, aus Oelschiefer. [Process for the production of hydrocarbons, including ethylene, acetylene, and benzene, from oil shale.] German (Fed. Rep.) auslegeschrift 1,047,352. Dec 24. 6 p.

005007550 Grazhulene, S.S.; Telegin, G.F.; Musikhin, L.A. (1977) Preparation of high-purity naphthalene. Journal of Applied Chemistry of the USSR 50(4):840-843.

005009475 Griffiths, E.; Evans, W.C. (1965) A cell-free perhydroxylase system from soil pseudomonads, with activity on aromatic hydrocarbons. Biochemical Journal 95(3):51-52.

005005374 Grob, K.; Grob, G. (1974) Organic substances in potable water and in its precursor: Part II. Applications in the area of Zurich. Journal of Chromatography 90(2):303-313.

005011334 Grunwald, E.; Butler, A.F. (1960) Salt-induced medium effects. I. Salt effects on the activity coefficients of naphthalene and 1-naphthoic acid in 50 wt.% dioxane-water. Journal of the American Chemical Society 82:5647-5654.

005013422 Guberska, J.; Draniak, B.; Szostak, A. (1976) Mozliwosci zastosowania chromatografii gazowej do oznaczania produktow utleniania o-ksylenu i naftalenu. [The possibility of using gas chromatography for determining o-xylene and naphthalene oxidation products.] Chemia Analityczna (Warsaw). [Analytical Chemistry.] 21(5):1161-1169.

005009491 Guseva, A.N.; Parnov, E.I. (1963) Rastvorimost' uglevodorodov naftalinovovo ryada v vode. [Solubility of hydrocarbons of the naphthalene series in water.] Vestnik Moskovskogo Universiteta, Khimiya. [Journal of Moscow University, Chemistry.] 18(4):80-82.

005006826 Guvernator, G.C., III; Gager, F.L., Jr.; Robb, E.W.; Bavley, A. (1965) Electron capture detection of gas-chromatographed polycyclic hydrocarbons. Journal of Gas Chromatography 3(11):363-367.

005018675 Halbwachs, G.; Hlawatsch, H. (1968) Photooxydation als Ursache von Pflanzenschaedigungen durch Teerdaempfe. [Photooxidation as the cause of plant damage by tar vapors.] Naturwissenschaften 55(2):90.

005006809 Haldeman, R.G.; Castellion, G., inventors; American Cyanamid Co., assignee (1963) Process for the dealkylation of alkyl naphthalene. U.S. patent 3,102,151. Aug 27. 3 p. Cl. 260-672.

005011485 Harburger Eisen- und Bronzewerke A.G., assignee (1929) Dispositif pour le pressage de matieres contenant des liquides.

005010511 Harley, J.; Dods, L. (1959) Some acquired haemolytic anaemias of childhood. Australasian Annals of Medicine 8(2):98-108.

005007669 Harris, R.P.; Berdugo, V.; O'Hara, S.C.M.; Corner, E.D.S. (1977) Accumulation of 14C-1-naphthalene by an oceanic and an estuarine copepod during long-term exposure to low-level concentrations. Marine Biology 42:187-195.

GS0022021 Harvey, Ronald G. and Halonen, Marilyn; Interaction between carcinogenic hydrocarbons and nucleosides. Cancer Research, 28, 2183-2186, November, 1968.

005006940 Hartzell, A. (1929) Tolerance of different species and varieties of plants to naphthalene vapor. Journal of Economic Entomology 22(2):354-360.

005007134 Hatano, H.; Yamamoto, Y.; Saito, M.; Mochida, E.; Watanabe, S. (1973) A high-speed liquid chromatograph with a flow-spectrofluorimetric detector and the ultramicro-determination of aromatic compounds. Journal of Chromatography 83:373-380.

005004733 Hatano, H.; Yamamoto, Y.; Saito, M.; Mochida, E.; Watanabe, S. (1973) A high-speed liquid chromatograph with a flow-spectrofluorimetric detector and the ultramicro-determination of aromatic compounds. Journal of Chromatography 83(1):373-380.

005007565 Hatch, L.F. (1963) What you should know about the chemistry of naphthalenes. Hydrocarbon Processing and Petroleum Refiner 42(3):113-118.

005005751 Heller, A.N., inventor; Allied Chemical Corp., assignee (1959) Process for production of high grade naphthalene and preparation of beta-naphthol from acidic waters therefrom. U.S. patent 2,884,463. Apr 28. 10 p. Cl. 260-628.

005010500 Henkel and Cie G.m.b.H., assignee (1958) A process for the separation of mixtures of solid and liquid substances occurring in tars. British patent specification 789,709. Jan 29. 4 p. Int. Cl. C 07c.

005005334 Herbes, S.E.; Schwall, L.R. (1978) Microbial transformation of polycyclic aromatic hydrocarbons in pristine and petroleum-contaminated sediments. Applied and Environmental Microbiology 35(2):306-316.

005005335 Herbes, S.E.; Schwall, L.R.; Williams, G.A. (1977) Rate of microbial transformation of polycyclic aromatic hydrocarbons: a chromatographic quantification procedure. Applied and Environmental Microbiology 34(2):244-246.

005008534 Herington, E.F.G.; Densham, A.B.; Malden, P.J. (1954) The preparation and freezing point of pure naphthalene. Journal of the Chemical Society 1954:2643-2644.

005006974 Hill, J.B., inventor; Barrett Co., assignee (1931) Purification of solid aromatic hydrocarbons. U.S. patent 1,819,680. Aug 18. 3 p.

005006705 Hirschfeld, T., inventor; (1972) Hydrocarbon detector. U.S. patent 3,695,847. Oct 3. 6 p. Int. Cl. G 01n 21/38,33/22; U.S. Cl. 23-232 R.

005009504 Holloway, G.A. (1973) A mould for the production of naphthalene bars for use in entomological cabinets. Australian Entomological Magazine 1(5):60-61.

005012634 Hrivnac, M.; Janak, J. (1959) Pouziti plynove chromatografie pri analytickem sledovani vyroby suroveho naftalenoveho oleje a jeho zpracovani na cisty naftalen. [Use of gas chromatography for analytical control of the production of raw naphthalene oil and its processing into pure naphthalene.] Chemicky Prumysl.

005009749 Hughes, W.C.; Wilson, H.N.; Bosanquet, C.H. (1936) Determination of naphthalene in tetrahydronaphthalene. Journal of the Society of Chemical Industry 55:86-88.

005010616 Ikemoto, F. (1971) Effects of cataractogenic compounds, fatty acids and related compouds [sic] on cation transport of the incubated lens. Osaka City Medical Journal 17(1):1-18.

005005327 Ishikura, T.; Nishida, H.; Tanno, K.; Miyachi, N.; Ozaki, A. (1968) Microbial production of salicylic acid from naphthalene. Part I. Isolation of the high yield strain and the flask scale culture. Agricultural and Biological Chemistry 32(1):12-20.

005005906 Jacobs, S.E. (1931) The influence of antiseptics on the bacterial and protozoan population of greenhouse soils: Part I. Naphthalene. Annals of Applied Biology 18(1):98-136.

005008033 Jacobziner, H.; Raybin, H.W. (1960) Digitoxin and naphthalene intoxications. New York State Journal of Medicine 60:3676-3678.

005012920 Jacobziner, H.; Raybin, H.W. (1962) Accidental chemical poisonings: naphthalene poisoning. New York State Journal of Medicine 62:2025-2028.

005005947 Jacobziner, H.; Raybin, H.W. (1964) Naphthalene poisoning. New York State Journal of Medicine 64(13):1762-1763.

005011119 Jacque, L.; Dumez, P., inventors; Pechiney (Compagnie de Produits Chimiques et Electrometallurgiques), assignee (1957) Sublimation. [Sublimation.] French brevet d'invention 1,148,715. Dec 13. 5 p. Int. Cl. B 01d.

005008997 James, R.W., inventor; (1930) Improvements in and relating to the distillation of normally solid substances. British patent specification 324,840. Feb 6. 6 p.

005005205 Jerina, D.M.; Daly, J.W.; Jeffrey, A.M.; Gibson, D.T. (1971) *Cis* -1,2-dihydroxy-1,2-dihydronaphthalene: a bacterial metabolite from naphthalene. Archives of Biochemistry and Biophysics 142(1):394-396.

005006640 Jerina, D.M.; Daly, J.W.; Witkop, B.; Zaltzman-Nirenberg, P.; Udenfriend, S. (1968) The role of arene oxide-oxepin systems in the metabolism of aromatic substrates. III. Formation of 1,2-naphthalene oxide from naphthalene by liver microsomes

005007661 Jinkins, R. (1940) Report on naphthalene in poultry lice products. Journal of the Association of Official Agricultural Chemists XXIII(3):556-557.

005005564 Johns, I.B.; McElhill, E.A.; Smith, J.O. (1962) Thermal stability of some organic compounds. Journal of Chemical and Engineering Data 7(2):277-281.

005004732 Johnson, E.; Abu-Shumays, A.; Abbott, S.R. (1977) Use of fluorescence detection in high-performance liquid chromatography. Journal of Chromatography 134(1):107-119.

005011112 Johnson, P.; Pover, W.F.R. (1963) Absorption of dicyclic compounds in lipid solution. Pages 186-196, *In* Proceedings of the 7th International Conference on Biochemical Problems of Lipids, Meeting on Fat Absorption; Jul 24-27, 1962, University of Birmingham, Birmingham, England. Amsterdam, Netherlands: Elsevier.

005005735 Johnston, J.B.; Gunsalus, I.C. (1977) Isolation of metabolic plasmid DNA from *Pseudomonas putida*. Biochemical and Biophysical Research Communications 75(1):13-19.

005007560 Jones, G.W.; Scott, G.S. (1946) Limits of Inflammability and Ignition Temperatures of Naphthalene. Washington, D.C.: United States Bureau of Mines. (One unpaged table; U.S. Bureau of Mines report of investigations no. 3881)

005007421 Jones, L.C., Jr.; Taylor, L.W. (1955) Far ultraviolet absorption spectra of unsaturated and aromatic hydrocarbons. Analytical Chemistry 27(2):228-237.

005013431 Jorissen, W.P.; Rutten, J. (1909) On naphthalene picrate and the quantitative determination of naphthalene. Journal of the Society of Chemical Industry XXVIII(22):1179-1180.

005011510 Kaasenbrood, P.J.C. (1963) Symposium "Kristallisatie": III. De kristallisatie van naftaline en anthraceen in de bezemkristallisator. [Symposium "Crystallization": III. Crystallization of naphthalene and anthracene in the brush-crystallizer.] Ingenieur (The Hague) 75(49):85-91.

005018579 Kaliszan, R.; Lamparczyk, H.; Radecki, A. (1979) A relationship between repression of dimethylnitrosamine-demethylase by polycyclic aromatic hydrocarbons and their shape. Biochemical Pharmacology 28(1):123-125.

005005729 Kappeler, T.; Wuhrmann, K. (1978) Microbial degradation of the water-soluble fraction of gas oil--II. Bioassays with pure strains. Water Research 12(5):335-342.

005011305 Karlinskii, L.E.; Chaiskii, V.Y., inventors; (1964) Sposob polucheniya naftalina. [A method of obtaining naphthalene.] U.S.S.R. opisanie izobreteniya 166,705. Dec 8. 1 p. Int. Cl. C 10c, C 07c.

005005662 Karr, C., Jr.; Comberiati, J.R.; Estep, P.A.; Mapstone, J.O., Jr. (1967) Effect of carbonization conditions on the composition of low-temperature tar from Pittsburgh-seam bituminous coal. Journal of the Institute of Fuel 40(323):561-563.

005008082 Kator, H.I. (1972) Utilization of Crude Oil Hydrocarbons by Mixed Cultures of Marine Bacteria [Doctoral Dissertation]. Tallahassee, Fla.: Florida State University. (Available from; University Microfilms, Ann Arbor, MI: order no. 73-194)

005011303 Katsobashvili, Y.R.; El'bert, E.I.; Belenko, Z.G., inventors; (1967) Sposob pererabotki kamennougol'nykh i drugikh smol. [A method of processing coal and other tars.] U.S.S.R. opisanie izobreteniya 203,652. Oct 9. 1 p. Int. Cl. C 10g.

005011612 Katsobashvili, Y.R.; El'bert, E.I.; Smirnov, V.K. (1964) Gidrokreking pekovykh distillyatov. [Hydrocracking of pitch distillates.] Khimiya i Tekhnologiya Topliv i Masel.

005007418 Kaye, W. (1962) Far-ultraviolet spectroscopic detection of gas chromatograph effluent. Analytical Chemistry 34(2):287-293.

005005648 Kelso, E.A., inventor; Esso Research and Engineering Co., assignee (1965) Combination hydrodealkylation and desulfurization process. U.S. patent 3,198,846. Aug 3. 5 p. Cl. 260-672.

005006235 Kemp, W.E.; Charlton, F.R.; Waldron, M.J., inventors; Koppers Co., assignee (1959) Purification of naphthalene. U.S. patent 2,916,533. Dec 8. 7 p. Cl. 260-674.

005005649 Kenton, J.R.; Pierson, R.E., inventors; Standard Oil Co., assignee (1965) Hydrocarbon conversion. U.S. patent 3,193,595. Jul 6. 11 p. Cl. 260-672.

005011130 Kessler, H.; Mueller, E. (1966) Duennschichtchromatographische Trennung mehrkerniger Aromaten mit Pikrinsaeure als Komplexbildner. [Thin-layer chromatographic separation of polynuclear aromatic compounds with picric acid as the complexing agent.] Journal of Chromatography 24(2):469-473.

005005194 Kierstead, H.A.; Turkevich, J. (1944) Viscosity and structure of pure hydrocarbons. Journal of Chemical Physics 12(1):24-27.

005006194 Kitai, A.; Tone, H.; Ishikura, T.; Ozaki, A. (1968) Microbial production of salicylic acid from naphthalene (II): product inhibitory kinetics and effect of product removal on the fermentation. Hakko Kogaku Zasshi. [Journal of Fermentation Technology.] 46(6):442-451.

005005939 Kiyohara, H.; Nagao, K. (1978) The catabolism of phenanthrene and naphthalene by bacteria. Journal of General Microbiology 105(1):69-75.

005005926 Kiyohara, H.; Nagao, K.; Nomi, R. (1976) Degradation of phenanthrene through o-phthalate by an *Aeromonas* sp. Agricultural and Biological Chemistry 40(6):1075-1082.

005005898 Klausmeier, R.E. (1959) Microbial oxidation of naphthalene

005005556 Klausmeier, R.E.; Strawinski, R.J. (1957) Microbial oxidation of naphthalene: I. Factors concerning salicylate accumulation. Journal of Bacteriology 73(4):461-464.

005005190 Klemm, L.H.; Airee, S.K. (1964) Gas-solid adsorption chromatography of some aromatic hydrocarbons and nitrogen heterocycles on alumina. Journal of Chromatography 13:40-47.

005012270 Klimisch, H.J.; Ambrosius, D. (1974) Gel-chromatographie polyzyklischer aromatischer Kohlenwasserstoffe.

005005195 Knipe, R.H.; Sponer, H.; Cooper, C.D. (1953) Temperature dependence of the naphthalene bands at 3200-2900A [letter]. Journal of Chemical Physics 21:376-377.

005014672 Koch, H.R.; Doldi, K.; Hockwin, O. (1977) Naphthalene cataracts in rats. Association of eye pigmentation and cataract development. Pages 293-303, In Progress of Lens Biochemistry Research, 1976. The Hague, Netherlands: Dr. W. Junk bv Publishers. (Documenta opthamologica proceedings series, vol. 8)

005015286 Kogan, L.A.; Noskova, E.I.; Bednov, V.M.; Tezyakova, E.I. (1972) Analiz naftalinsoderzhashchego syr'ya metodom kapillyarnoi gazovoi khromatografii. [The analysis of naphthalene-containing raw materials by capillary gas chromatography.] Voprosy Tekhnologii Ulavlivaniya i Pererabotki Produktov Koksovaniya. [Problems of the Technology of Trapping and Processing Coking Products.] 1:154-160.

005012325 Koksharov, V.G.; Grinevich, N.A.; Rus'ianova, N.D.; Grigorovich, M.M.; Kern, A.A.; Khomutinkin, G.V.; Sizov, M.N. (1979) Vliyanie fenolov i osnovanii na ochistku naftalina ozonom.

005010794 Konar, N.A.; Roy, H.K.; De, M.N. (1939) Naphthalene poisoning. Indian Medical Gazette 74:723-725.

005015487 Konoplev, A. (1938) Sravnitel'naya otsenka metodov opredeleniya v moloke fenola, krezola, naftalina i formal'degida. [A comparison of methods of detecting phenol, cresol, naphthalene and formaldehyde in milk.] Voprosy Pitaniya. [Problems of Nutrition.] 7(6):127-130.

005008236 Korn, S.; Moles, D.A.; Rice, S.D. (1979) Effects of temperature on the median tolerance limit of pink salmon and shrimp exposed to toluene, naphthalene, and Cook Inlet crude oil. Bulletin of Environmental Contamination and Toxicology 21(4/5):521-525.

005012032 Korshunov, A.V.; Bondarev, A.F. (1964) Shirina linii i interpretatsiia chastot spektrov rasseianiia malogo smeshcheniia. [Line width and interpretation of low-frequency scattering spectra.] Vestnik Leningradskogo Universiteta, Fizika, Khimiya. [Journal of Leningrad University, Physics and Chemistry.] 3(15):22-25.

005011948 Kreshkov, A.P.; Mikhailenko, I.I.; Smirenkina, I.P. (1958) Opredelenie naftalina alpha- i beta-khlornaftalina spektrofotometricheskim metodom v ul'trafioletovoi chektra.

005009052 Krishnan, N.R.; Anand, P.N.; Lal, H.G.; Parashar, S.K. (1976) Naphthalene moth ball induced acute haemolytic anaemia. Medical Journal of the Armed Forces of India XXXII(2):200-205.

005005663 Krstulovic, A.M.; Rosie, D.M.; Brown, P.R. (1976) Selective monitoring of polynuclear aromatic hydrocarbons by high pressure liquid chromatography with a variable wavelength detector. Analytical Chemistry 48(9):1383-1386.

005007441 Krzesz, Z., inventor; Dominion Tar & Chemical Co., assignee (1955) Naphthalene refining by washing with a surface active agent. U.S. patent 2,711,432. Jun 21. 2 p. Cl. 260-674.

005009737 Kucharczyk, N.; Fohl, J.; Vymetal, J. (1963) Duennschichtchromatographie von aromatischen Kohlenwasserstoffen und einigen heterocyclischen Verbindungen.

005017034 Kudchadker, A.P.; Kudchadker, S.A.; Wilhoit, R.C. (1978) Naphthalene. Washington, D.C.: American Petroleum Institute, Refining Department. (API monograph series no. 707)

005011518 Kulczycka, J.; Rusin, A. (1975) Zastosowanie chromatografii zelowej oraz spektrofotometrii w nadfiolecie do analizy skladu hydrogenizatow weglowych. [Application of gel chromatography and ultraviolet spectrophotometry to the analysis of the composition of coal hydrogenation products.] Koks, Smola, Gaz.

005009746 Kulkarni, S.B. (1953) Molecular weight determination by thermistors. Nature 171(4344):219-220.

005016232 Kvasnikov, E.I.; Tin'yanova, N.Z. (1970) Proteolitychna aktyvnist' deyakykh shtamiv rodu Pseudomonas na mineral'nomu seredovyshchi z naftalinom. [Proteolytic activity of some strains from the Pseudomonas genus on mineral medium with naphthalene.] Mikrobiologichnii Zhurnal (Kiev). [Journal of Microbiology.] 32(4):416-419.

005011021 Lang, K.F.; Damm, P.; Turowski, J., inventors; Ruetgerswerke A.G., assignee (1957) Verfahren zur Naphthalingewinnung aus naphthalinhaltigen Fraktionen der Teerdestillation. [Process for recovery of naphthalene from naphthalene containing fractions from tar distillation.] German (Fed. Rep.) patentschrift 824,494. May 16. 2 p. Int. Cl. C 10c; C 07c.

005005653 Lang, K.F.; Damm, P.; Turowski, J., inventors; Rutgerswerke-A.G., assignee (1957) Method of producing crystalline naphthalene. U.S. patent 2,790,017. Apr 23. 3 p. Cl. 260-674.

005012912 Lee, W.Y.; Nicol, J.A.C. (1978) Individual and combined toxicity of some petroleum aromatics to the marine amphipod Elasmopus pectenicrus. Marine Biology 48(3):215-222.

005005732 Lee, W.Y.; Nicol, J.A.C. (1978) The effect of naphthalene on survival and activity of the amphipod Parhyale. Bulletin of Environmental Contamination and Toxicology 20(2):233-240.

005005203 Leermakers, P.A.; Thomas, H.T.; Weis, L.D.; James, F.C. (1966) Spectra and photochemistry of molecules adsorbed on silica gel. IV. Journal of the American Chemical Society 88(22):5075-5083.

005008128 Legacheva, V.V.; Zykov, D.D. (1966) Crystallization of naphthalene from dilute oils by contact cooling. Coke and Chemistry USSR. A translation of: Koks i Khimiya. (9):32-35.

005008127 Legacheva, V.V.; Zykov, D.D.; Ocheret, A.S. (1966) Direct crystallization of naphthalene-rich oils using a coolant. Coke and Chemistry USSR. A translation of: Koks i Khimiya. (2):28-31.

005009503 Lim, T.K.; Taurins, A.; Whitehead, M.A. (1966) Automatic direct analysis of AB* nuclear magnetic resonance spectra. Canadian Journal of Chemistry 44(10):1211-1223.

005007419 Lippincott, E.R.; Weir, C.E.; Van Valkenburg, A.; Bunting, E.N. (1960) Studies of infrared absorption spectra of solids at high pressures. Spectrochimica Acta 16:58-73.

005007572 Lovins, R.E.; Ellis, S.R.; Tolbert, G.D.; McKinney, C.R. (1973) Liquid chromatography--mass spectrometry: coupling of a liquid chromatograph to a mass spectrometer. Analytical Chemistry 45(8):1553-1556.

005008825 Ludzack, F.J.; Ettinger, M.B. (1963) Biodegradability of organic chemicals isolated from rivers. Pages 278-282,*In Engineering Bulletin of Purdue University, Engineering Extension Series No. 115. Lafayette, Ind.: Purdue University, Engineering Extension Department.

005006988 MacGregor, R.R. (1954) Naphthalene poisoning from the ingestion of moth balls. Canadian Medical Association Journal 70:313-314.

005008114 Mair, B.J.; Streiff, A.J. (1940) Separation of the aromatic hydrocarbons, and the isolation of n-dodecane, naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene from the kerosene fraction of petroleum. Journal of Research of the National Bureau of Standards 24:395-414.

005010914 Malissa, H. (1966) Automation in organic micro-elemental analysis. Pure and Applied Chemistry 13(4):523-541.

005011526 Markus, G.A. (1963) Novye reaktivny na baze produktov koksokhimicheskogo proizvodstva. [New reagents based on coke and chemical products.] Koks i Khimiya. [Coke and Chemistry.] (2):52-54.

005015062 Markus, G.A.; Girzheva, G.D; Girzhev, A.L.; Travtsova, T.P.; Gertner, L.S. (1975) Production of refined naphthalene grades from sulphur-rich feedstocks. Coke and Chemistry USSR (English Translation) (4):26-29.

005009747 Marsh, J.K. (1925) Emission band spectra of aromatic compounds. Part II.--Their origin. Philosophical Magazine 49:1206-1216.

005012040 Martin, M.; Scharfe, G., inventors; Bayer AG, assignee (1976) Verfahren zur Entfernung von organischen Verbindungen aus Gasen. [Method for the separation of organic compounds from gases.] German (Fed. Rep.) offenlegungsschrift 24,36,369. Feb 5. 12 p.

005009054 Martonova, M.; Skarka, B.; Radej, Z. (1972) Degradation of naphthalene to salicylic acid by cultures of *Pseudomonas denitrificans* and *Achromobacter* sp. from the effluents of petroleum refinery. Folia Microbiologica (Praque) 17(1):63-65.

005005667 Mason, J.C., Jr., inventor; Sun Oil Co., assignee (1964) Preparation of naphthalene and dimethylnaphthalenes. U.S. patent 3,153,675. Oct 20. 4 p. Cl. 260-668.

005011479 Masuda, Y.; Mori, K.; Kuratsune, M. (1966) Polycyclic aromatic hydrocarbons in common Japanese foods. I. Broiled fish, roasted barley, shoyu, and caramel. Gann 57(2):133-142.

005006668 Matt, M.C. (1930) The quantitative estimation of naphthalene in oils. Chemist-Analyst 19(3):15.

005006857 May, W.E.; Wasik, S.P.; Freeman, D.H. (1978) Determination of the solubility behavior of some polycyclic aromatic hydrocarbons in water. Analytical Chemistry 50(7):997-1000.

005008025 Mayneord, W.V.; Roe, E.M.F. (1935) The ultra-violet absorption spectra of some complex aromatic hydrocarbons--I. Proceedings of the Royal Society, Series A: Mathematical and Physical Sciences 152:299-324.

005008024 Mayneord, W.V.; Roe, E.M.F. (1937) The ultra-violet absorption spectra of some complex aromatic hydrocarbons--II. Proceedings of the Royal Society, Series A: Mathematical and Physical Sciences 158:634-650.

005005665 McKinnis, A.C., inventor; Union Oil Co. of California, assignee (1962) Recovery of petroleum naphthalene. U.S. patent 3,043,890. Jul 10. 3 p. Cl. 260-674.

005006854 McTaggart, N.G.; Luke, L.A. (1972) Hydrocarbon type analysis of petroleum distillates by gas solid chromatography. Energy Digest 1(2):46-50.

005015756 Miller, G.A. (1963) Vapor pressure of naphthalene: thermodynamic consistency with proposed frequency assignments. Journal of Chemical and Engineering Data 8(1):69-72.

005007575 Miller, S.P., inventor; Barrett Co., assignee (1922) Purification of naphthalene. U.S. patent 1,438,710. Dec 12. 4 p.

005008815 Miller, S.P., inventor; Barrett Co., assignee (1940) Process for crystallizing naphthalene. U.S. patent 2,207,752. Jul 16. 8 p. Cl. 260-674.

005006935 Miller, T.A.; Prater, B.; Lee, J.K.; Adams, R.N. (1965) Tracer diffusion coefficients of naphthalene, biphenyl, and anthracene

005007659 Miller, W.L. (1934) Determination of naphthalene in insecticides. Journal of the Association of Official Agricultural Chemists XVII(2):308-313.

005006227 Modi, V.V.; Patel, R.N. (1968) Salicylate formation from naphthalene by *Pseudomonas aeruginosa*. Applied Microbiology 16(1):172-173.

005008089 Mohler, F.L.; Dibeler, V.H.; Williamson, L.; Dean, H. (1952) Mass spectra of deuteroacetylenes, monodeuterobenzene, and deuteronaphthalenes. Journal of Research of the National Bureau of Standards 48(3):188-192.

005015361 Molinari, J.G.D. (1961) The Proabd refiner. Industrial Chemist 37:323-326.

005011301 Movchan, A.T.; Kirilenko, G.V., inventors; (1962) Kristallizator dlya naftalinovoi fraktsii. [A crystallizer for the naphthalene fraction.] U.S.S.R. opisanie izobreteniya 148,015. Jun 21. 2 p.

005005897 Mudaliar, C.R. (1935) The effect of naphthalene on germination of paddy seed. Madras Agricultural Journal XXXIII(6):223-231.

005006936 Mukerjee, P.; Cardinal, J.R. (1976) Solubilization as a method for studying self-association: solubility of naphthalene in the bile salt sodium cholate and the complex pattern of its aggregation. Journal of Pharmaceutical Sciences 65(6):882-886.

005006193 Murphy, J.F.; Stone, R.W. (1955) The bacterial dissimilation of naphthalene. Canadian Journal of Microbiology 1(7):579-588.

005005365 Natusch, D.F.S.; Tomkins, B.A. (1978) Isolation of polycyclic organic compounds by solvent extraction with dimethyl sulfoxide. Analytical Chemistry 50(11):1429-1434.

005008030 Nazarov, V.G.; Dinelt, M.V.; Gainanov, S.A.; Kotovich, A.A. (1968) Production of crude benzole and naphthalene oil. Coke and Chemistry USSR. A translation of: Koks i Khimiya. (3):28-32.

005013529 Nelson, O.A.; Senseman, C.E. (1922) Vapor pressure determinations on naphthalene, anthracene, phenanthrene, and anthraquinone between their melting and boiling points. Journal of Industrial and Engineering Chemistry 14(1):58-62.

005007578 Nelson, O.A.; Senseman, C.E. (1923) Equations for vapor pressures and latent heats of vaporization of naphthalene, anthracene, phenanthrene, and anthraquinone. Industrial and Engineering Chemistry 15(6):621-622.

005014670 Netter, K.J. (1968) Fluorimetrische Messungen zur Naphthalin-Hydroxylierung. [Fluorometry measurements on naphthalene hydroxylation.] Naunyn-Schmeideberg's Archiv fuer Pharmakologie 260(2):181.

005015080 Netter, K.J. (1969) Untersuchungen zur mikrosomalen Naphthalinhydroxylierung. [The hydroxylation of naphthalene by liver microsomes.] Naunyn-Schmiedebergs Archiv fuer Experimentelle Pathologie und Pharmakologie 262(3):375-387.

005008095 Nonaka, A. (1972) Gas-solid chromatography of organic compounds using steam as the carrier gas. Analytical Chemistry 44(2):271-276.

005008119 Norton, C.J. (1961) Naphthalene as an isolatable reaction intermediate in the catalytic vapor-phase oxidation of methylnaphthalenes to phthalic anhydride. Bulletin of the Chemical Society of Japan 34(10):1545-1547.

005007678 Norton, C.J.; Moss, T.E. (1964) Oxidative dealkylation of alkylaromatic hydrocarbons: selective vapor-phase catalytic oxidation of alkylaromatic hydrocarbons to their parent homologs. Industrial and Engineering Chemistry, Process Design and Development 3(1):23-32.

005011292 Novak, J.; Hrivnac, M., inventors; (1963) Zpusob ziskavani cistych aromatickych uhlovodiku heterocyklickych latek, fenolu a zasad z jejich technickych smesi. [Preparation of pure aromatic hydrocarbons, heterocyclic compounds, phenols and bases from their technical mixes.] Czechoslovakian patentnovy spis 108,020. Aug 15. 5 p.

005007955 Novikov, V.N.; Bednov, V.M.; Khomutinkin, G.V.; Zubok, A.M. (1966) The production of distilled naphthalene. Coke and Chemistry USSR. A translation of: Koks i Khimiya. (7):37-39.

005011530 Obolentsev, R.D.; Aivazov, B.V. (1957) K voprosu o khromatograficheskom vydelenii aromaticheskikh uglevodorodov iz ikh smesi s seraorganicheskimi soedineniyami. [The problem of the chromatographic separation of aromatic hydrocarbons from their mixtures with organic sulfur compounds.] Doklady Akademii Nauk SSSR. [Proceedings of the Academy of Sciences of the USSR.] 114(4):803-806.

005011548 Odell, W.W. (1922) Preparation and Uses of Tar and Its Simple Crude Derivatives. Washington, D.C.: U.S. Bureau of Mines. (U.S. Bureau of Mines technical paper no. 268)

005005655 Oesch, F.; Jerina, D.M.; Daly, J.W.; Lu, A.Y.H.; Kuntzman, R.; Conney, A.H. (1972) A reconstituted microsomal enzyme system that converts naphthalene to *trans* -1,2-dihydroxy-1,2-dihydronaphthalene via naphthalene-1,2-oxide: presence of epoxide hydrase in cytochrome P-450 and P-448 fractions. Archives of Biochemistry and Biophysics 153(1):62-67.

005005407 Okey, R.W.; Bogan, R.H. (1965) Apparent involvement of electronic mechanisms in limiting the microbial metabolism of pesticides. Journal of the Water Pollution Control Federation 37(5):692-712.

005005238 Onadeko, B.O.; Bademosi, O. (1974) Glucose-6-phosphate dehydrogenase deficiency and intravascular haemolysis. Irish Journal of Medical Science 143(4):208-213.

005008696 Ott, F.S.; Harris, R.P.; O'Hara, S.C.M. (1978) Acute and sublethal toxicity of naphthalene and three methylated derivatives to the estuarine copepod, *Eurytemora affinis*. Marine Environmental Research 1(1):49-58.

005011492 Pakter, M.K.; Pats, B.M.; Spitsyn, A.K. (1968) O vybo. pokazàtelei dlya otsenki sortnosti glubokoochishchennogo naftalina. [Criteria for grading highly refined naphthalene.] Koks i Khimiya. [Coke and Chemistry.] (2):29-32.

0050113[illegible] Pal'chikov, G.F.; Mezhlumova, A.I.; Krichko, A.A.; Kaganer, G.S.; Stepuro, S.I.; Brovenko, A.V., inventors; (1965) Sposob polucheniia naftalina. [Process for producing naphthalene.] U.S.S.R. opisanie izobreteniia 168,273. Feb 18. 2 p. Int. Cl. C 07c.

005011124 Palivoda, N.I. (1972) Otravlenie naftalinom. [Naphthalene poisoning.] Zdravookhranenie Belorussii. [Public Health Service of White Russia.] 18(7):81-82.

005007420 Parker, C.A.; Hatchard, C.G. (1962) The possibilities of phosphorescence measurement in chemical analysis: tests with a new instrument. Analyst 87:664-676.

005005204 Passerini, R.; Ross, I.G. (1954) Temperature dependence of the ultraviolet absorption spectrum of naphthalene in solution. Journal of Chemical Physics 22(6):1012-1016.

005010494 Patel, T.R. (1974) Bacterial *cis* -naphthalene dihydrodiol dehydrogenase: purification and properties. Dissertation Abstracts International B 35(8):4056-4057.

005005202 Patel, T.R.; Gibson, D.T. (1974) Purification and properties of (+)- *cis* -naphthalene dihydrodiol dehydrogenase of *Pseudomonas putida*. Journal of Bacteriology 119(3):879-888.

005005930 Patel, T.R.; Gibson, D.T. (1976) Bacterial *cis* -dihydrodiol dehydrogenases: comparison of physicochemical and immunological properties. Journal of Bacteriology 128(3):842-850.

005019690 Pats, B.M. (1957) Sravnenie razlichnykh skhem polucheniya tekhnicheskogo naftalina. [Comparison of different methods for producing crude naphthalene.] Koks i Khimiya. [Coke and Chemistry.] (5):39-41.

005011320 Pats, B.M.; Nepomniashchaia, A.S.; Ozerskii, G.M.; Chernomordik, E.Y.; Markus, G.A., inventors; (1968) Sposob ochistki naftalina. [Process for purifying naphthalene.] U.S.S.R. opisanie izobreteniia 210,847. Feb 8. 3 p. Int. Cl. C 07c.

005011311 Pats, B.M.; Nepomnyashchaya, A.S. (1959) Tionaften—cernistyi sputnik naftalina. [Thianaphthene—a sulfur analog of naphthalene.] Khimicheskaya Promyshlennost (Moscow).

005006679 Pats, B.M.; Pakter, M.K. (1966) Behavior of impurities during the rectification of naphthalene. Coke and Chemistry (10):49-51.

005007544 Pavlu, J. (1966) The chromatographic separation of polycyclic aromatic hydrocarbons by thin-layer chromatography. Acta Universitatis Carolinae Medica 12(3):225-228.

005015770 Peters, G. (1938) Die biologisch-chemische Eignungspruefung gasfoermig wirkender Insektizide.] [The biological-chemical evaluation of gaseous insecticides.] Anzeiger fuer Schaedlingskunde 14(10):116-122.

005007424 Peters, H. (1959) Ultraviolet absorption spectra of phthalic anhydride and related substances: analytical method for naphthalene and 1,4-naphthoquinone. Analytical Chemistry 31(8):1326-1331.

005015063 Petrowitz, H.J. (1964) Zur Duennschichtchromatographie mehrkerniger aromatischer Kohlenwasserstoffe. [Thin-layer chromatography of polynuclear aromatic hydrocarbons.] Pages 132-137, In Thin Layer Chromatography, Proceedings of the Symposium; May 2-3, 1963, Rome, Italy. Edited by G.B. Marini-Bettolo. Amsterdam, Netherlands: Elsevier.

005007540 Phillips, W.E., Jr.; Brown, L.R. (1975) The effect of elevated temperature on the aerobic microbiological treatment of a petroleum refinery wastewater. Pages 296-304, In Developments in Industrial Microbiology. No. 16. Washington, D.C.: American Institute of Biological Sciences.

005005198 Pimentel, G.C.; McClellan, A.L. (1952) The infrared spectra of naphthalene crystals, vapor, and solutions. Journal of Chemical Physics 20(2):270-277.

005005199 Pimentel, G.C.; McClellan, A.L.; Person, W.B.; Schnepp, O. (1955) Interpretation of the infrared spectrum of a molecular crystal:naphthalene. Journal of Chemical Physics 23(2):234-237.

005011954 Politzer, P.; Daiker, K.C. (1977) Some possible products of the reaction of 0(hydrocarbons. Pages 331-344, In Excited States in Organic Chemistry and Biochemistry. Edited by B. Pullman and N. Goldblum. Dordrecht, Holland: D. Reidel Publishing Co. (Jerusalem symposium on quantum chemistry and biochemistry no.10)

005008096 Popl, M.; Dolansky, V.; Mostecky, J. (1972) Calculation of retention volumes in gradient elution adsorption chromatography. Analytical Chemistry 44(12):2082-2084.

005006112 Pople, J.A.; Schneider, W.G.; Bernstein, H.J. (1957) The analysis of nuclear magnetic resonance spectra: II. Two pairs of two equivalent nuclei. Canadian Journal of Chemistry 35:1060-1072.

005006836 Price, W.C.; Bralsford, R.; Harris, P.V.; Ridley, R.G. (1959) Ultra-violet spectra and ionization potentials of hydrocarbon molecules. Spectrochimica Acta 14:45-55.

005018860 Prikhot'ko, A.F. (1949) Zakonomernosti v spektre pogloshcheniya parov naftalina. [Absorption spectrum of naphthalene vapor.] Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki. [Journal of Experimental and Theoretical Physics.] 19(6):487-492.

005012046 Privalov, V.E.; Gurevich, B.S.; Bechov, V.M. (1965) Ochistka fugovannogo naftalina kristallizatsiei-plableniem.

005014867 Prochownik, X. (1911) Ein toedlich verlaufener Fall von Naphthalinvergiftung. [A fatally progressive case of naphthalene poisoning.] Therapeutische Monatshefte XXV:489-490.

005007131 Rao, H.S.; Basu, A.N.; Lahiri, A. (1952) The nature of coal bitumens--viscosity and molecular weight of coal degradation products. Journal of Scientific and Industrial Research, Section B 11:234-239.

005006233 Ratledge, C.; Winder, F.G. (1966) Biosynthesis and utilization of aromatic compounds by *Mycobacterium smegmatis* with particular reference to the origin of salicylic acid. Biochemical Journal 101:274-283.

005006103 Ray, A.K. (1950) On the Raman spectra of naphthalene at low temperature. Indian Journal of Physics 24:539-544.

005006232 Ray, B.B.; Das Gupta, K.; Bose, H.; Das, S.R. (1940) The fluorescence of organic compounds by X-rays [letter]. Science and Culture V(8):496-497.

005010161 Roebuck, A.K.; Evering, B.L. (1957) Hydrocracking an aromatic extract to naphthalene and 100-octane gasoline. Preprints, Division of Petroleum Chemistry, American Chemical Society 2(3):123-129.

005006569 Rogoff, M.H. (1962) Chemistry of oxidation of polycyclic aromatic hydrocarbons by soil pseudomonads. Journal of Bacteriology 83:998-1004.

005016225 Rogoff, M.H. (1963) Mode of oxidation of polycyclic aromatic hydrocarbons by bacteria. Pages 46-50, *In* Developments in Industrial Microbiology. Vol. 4. Washington, D.C.: American Institute of Biological Sciences.

005008807 Ross, G.S.; Frolen, L.J. (1963) Chemical purity by dielectric cryometry. Journal of Research of the National Bureau of Standards 67A(6):607-614.

005012033 Schubert, S. (1951) Eine einfache optische Schnellmethode zur Bestimmung des Naphthalingehaltes in Waschoelen. [A simple optical rapid method for the determination of the naphthalene content in wash oils.] Gas- und Wasserfach 92(19):277-278.

005006991 Schulze, J.E., inventor; (1946) Process for the manufacture of polynuclear aromatic hydrocarbons. U.S. patent 2,403,127. Jul 2. 7 p. Cl. 260-674.

005008112 Schwarz, F.P. (1977) Determination of temperature dependence of solubilities of polycyclic aromatic hydrocarbons in aqueous solutions by a fluorescence method. Journal of Chemical and Engineering Data 22(3):273-277.

005010394 Schwarz, F.P.; Wasik, S.P. (1976) Fluorescence measurements of carcinogenic and polycyclic aromatic hydrocarbons in water. Pages 1-5, In International Conference on Environmental Sensing and Assessment, Proceedings; Sep 14-19, 1975, Las Vegas, Nevada. Vol. 2. Piscataway, N.J.: Institute of Electrical and Electronics Engineers.

005006557 Schwarz, F.P.; Wasik, S.P. (1977) A fluorescence method for the measurement of the partition coefficients of naphthalene, 1-methylnaphthalene, and 1-ethylnaphthalene in water. Journal of Chemical and Engineering Data 22(3):270-273.

005008795 Scott, R.; Joscelyne, E.H., inventors; Midland Tar Distillers Ltd., assignee (1949) Improvements in or relating to the purification of naphthalene. British patent specification 628,403. Aug 29. 3 p.

005006878 Scott, R.; Joscelyne, E.H., inventors; Midland Tar Distillers, assignee (1952) Purification of naphthalene. U.S. patent 2,598,449. May 27. 3 p. Cl. 260-674.

005005387 Sears, G.W.; Hopke, E.R. (1954) The vapor pressure of naphthalene. Journal of the American Chemical Society 76:2026.

005008113 Sen, D.K.; Das, B.P.; Nair, C.S.B. (1977) Recovery and utilization of chemicals from by-product wastes of the coking industry. Chemical Age of India 28(1):55-65.

005007675 Serrurier, R. (1976) Prospects for marketing coal gasification byproducts. Hydrocarbon Processing 55(9):253-257.

005006858 Seshan, P.K. (1936) The absorption spectra of some aromatic compounds. Part I.--Hydrocarbons. Proceedings of the Indian Academy of Sciences, Section A III:148-171.

005007665 Shamsuzzaman, K.M.; Barnsley, E.A. (1974) The regulation of naphthalene metabolism in pseudomonads. Biochemical and Biophysical Research Communications 60(2):582-589.

005011959 Sharma, N.L.; Singh, R.N.; Natu, N.K. (1967) Accidental poisoning in infancy and childhood. Journal of the Indian Medical Association 48(1):20-25.

005008280 Sherwood, J.N. (1969) Purification and growth of large anthracene crystals. Pages 157-168, In Purification of Inorganic and Organic Materials: Techniques of Fractional Solidification. Edited by M. Zief. New York: Marcel Dekker.

005011309 Shuikin, N.I.; Naryshkina, T.I., inventors; (1964) Sposob polucheniya naftalina. [A method of obtaining naphthalene.] U.S.S.R. opisanie izobreteniya 166,659. Dec 1. 1 p. Int. Cl. C 07c.

005006566 Singh, H.D.; Lonsane, B.K.; Barua, P.K.; Baruah, J.N.; Iyengar, M.S. (1974) Formation of salicylic acid from naphthalene by microorganisms: Part II—factors affecting salicylic acid accumulation. Indian Journal of Experimental Biology 12(2):162-165.

005013430 Singh, K.; Singh, J.B. (1974) A study of some chemicals as nitrification regulators and their effect on total bacteria and azotobacter. Chemicals and Petro-Chemicals Journal 5(9):25-28.

005007088 Sisco, W.E.; Shenian, P.; Moyer, M.I., inventors; American Cyanamid Co., assignee (1960) Process for refining naphthalene. U.S. patent 2,955,144. Oct 4. 3 p. Cl. 260-674.

005007253 Skeist Laboratories (1968) Chemical By-Products from Coal. Washington, D.C.: Department of the Interior, Office of Coal Research. (Available from; NTIS, Springfield, VA: PB-180 878; Department of the Interior, Office of Coal Research, Research and Development report no. 43)

005011469 Skinner, G.R.; Smith, R.E. (1977) Method for selected polyaromatics in mineral oil by linear elution chromatography as a rapid alternate for FDA method 121.2589 (c) (3). Journal of Chromatographic Science 15(2):75-78.

005011534 Sklyarenko, S.I.; Markin, B.I.; Belyaeva, L.B. (1958) Opredelenie davleniya nasyshchennogo para maloletuchnikh veshchestv.

005012923 Skopnik, A. von (1927) Moderne Herstellung von Reinnaphthalin.

005009511 Skotnicky, J. (1953) The dependence of the melting point on the pressure. Czechoslovak Journal of Physics. A translation of: Ceskoslovensky Casopis pro Fysiku 3(3):225-230.

005012044 Skryabin, G.K.; Starovoitov, I.I.; Borisoglebskaya, A.N.; Boronin, A.M. (1978) Okislenie naftalina shtammom Pseudomonas putida, nesushchim mutantnuyu plazmidu. [Oxidation of naphthalene by a strain of Pseudomonas putida carrying a mutant plasmid.] Mikrobiologiya. [Microbiology.] XLVII(2):273-277.

005008574 Small, T. (1934) "Little potato" disease. Gardeners' Chronicle 96(2486):128.

005011522 Smetanina, E.K. (1961) Povyshenie koeffitsientov izvlecheniya naftalina i fenolov iz kamennougol'nom smoly. [Increasing the recovery of naphthalene and phenols from coal tar.] Koks i Khimiya. [Coke and Chemistry.] (9):52-54.

005006801 Smith, R.V.; Rosazza, J.P. (1974) Microbial models of mammalian metabolism. Aromatic hydroxylation. Archives of Biochemistry and Biophysics 161(2):551-558.

005005568 Smith, R.V.; Rosazza, J.P.; Nelson, R.A. (1974) Thin-layer chromatographic determination of simple phenols in microbial extracts. Journal of Chromatography 95(2):247-249.

005011282 Societe pour L'Exploitation des Procedes Ab-der-Halden, assignee (1951) Procede de fabrication de naphtaline pure. [Process for the manufacture of pure naphthalene.] French brevet d'invention 977,704. Apr 4. 2 p.

005007083 Soemantri, R.M.; Waterman, H.I. (1957) The separation of naphthalene and its hydrogenated products by vapour-phase chromatography. Journal of the Institute of Petroleum 43(399):94-99.

005009510 Sojak, L.; Barnoky, L. (1977) GC retention data of naphthalene and biphenyl and some of their methyl isomers: table 1034. Journal of Chromatography 141(2):31.

005017429 Solari, A.A.; Painceira, M.T. (1976) Estudio de una *Pseudomonas* aislada del suelo que es capaz de utilizar el naftaleno como fuente de carbono. [Study of a *Pseudomonas* isolated from soil capable of utilizing naphthalene as a source of carbon.] Acta Bioquimica Clinica Latinoamericana X(4):321-326.

005016242 Solari, A.A.; Painceira, M.T. (1976) Transferencia de la capacidad de utilizar el naftaleno como unica fuente de carbono que tiene la *Pseudomonas Ex* a la *Pseudomonas aeruginosa*. [Transfer of the capacity possessed by *Pseudomonas Ex* to utilize naphthalene as sole source of carbon to *Pseudomonas aeruginosa*.] Acta Bioquimica Clinica Latinoamericana X(4):327-330.

005006800 Soto, C.; Hellebust, J.A.; Hutchinson, T.C.; Sawa, T. (1975) Effect of naphthalene and aqueous crude oil extracts on the green flagellate *Chlamydomonas angulosa*. I. Growth. Canadian Journal of Botany 53(2):109-117.

005005395 Soulages, N.L.; Brieva, A.M. (1974) Gas chromatographic determination of the paraffin and naphthene content in saturated hydrocarbon distillates with porous layer open tubular columns of molecular sieve 13X. Journal of Chromatography 101(2):365-371.

005006098 Speckhardt, G.; Hennig, K., inventors; (1962) Process for the recovery of naphthalene. U.S. patent 3,067,269. Dec 4. 4 p. Cl. 260-674.

005011290 Speckhardt, G., inventor; Gelsenkirchener Bergwerks-A.G., assignee (1961) Verfahren zur Gewinnung von Reinnaphthalin durch Behandeln mit Loesungsmitteln. [Procedure for purification of naphthalene by treatment with solvents.] German (Fed. Rep.) patentschrift 974,925. May 31. 2 p. Int. Cl. C 07c.

005005232 Srivastava, S.K.; Nath, R. (1969) Metabolic alterations in experimental cataract. Part I. Inhibition of lactate dehydrogenase and appearance of o-diphenol oxidase in cataractous lens of naphthalene fed rabbits. Indian Journal of Medical Research 57(2):225-227.

005007252 Stanford Research Institute (1977) Profiles on Occupational Hazards for Criteria Document Priorities. Cincinnati, Ohio: National Institute for Occupational Safety and Health. (Available from; NTIS, Springfield, VA: PB-274 073)

005006565 Starovoitov, I.I.; Boronin, A.M.; Skryabin, G.K. (1976) Comparative study of the pathways of naphthalene catabolism in two strains of *Pseudomonas putida*. Doklady Biochemistry 228(1/6):213-215.

005010155 Strawinski, R.J.; Stone, R.W. (1954) Biological oxidation of naphthalene. Canadian Journal of Microbiology 1(3):206-210.

005006665 Streiff, A.J.; Hulme, A.R.; Cowie, P.A.; Krouskop, N.C.; Rossini, F.D. (1955) Purification, purity, and freezing points of sixty-four American Petroleum Institute standard and research hydrocarbons. Analytical Chemistry 27(3):411-415.

005012629 Strubert, W. (1973) Trennung von mehrkernigen Aromaten auf Kieselgel. Detektion im Nanogramm- bzw. ppb-Bereich.

005011947 Sulimov, A.D.; Kozhina, I.N.; Trakhtenberg, D.M. (1965) Poluchenie naftalina iz neftyanogo syriya. [The production of naphthalene from petroleum crude.] Khimiya i Tekhnologiya Topliv i Masel.

005006663 Sullivan, W.N.; Goodhue, L.D.; Fales, J.H. (1941) Application of the aerosol to fumigation: I. Stabilization of a naphthalene aerosol. Journal of Economic Entomology 34(5):650-653.

005006664 Sullivan, W.N.; McGovran, E.R.; Goodhue, L.D. (1941) Fumigating action of a mixture of orthodichlorobenzene and naphthalene applied by a new method. Journal of Economic Entomology 34(1):79-80.

005009516 Sunier, A.A.; Rosenblum, C. (1928) The latent heat of fusion of naphthalene from new solubility data. Journal of Physical Chemistry 32:1049-1055.

005010178 Suzuki, K.; Taniguchi, Y.; Ishigami, T.; Tsuchiya, M. (1975) The effect of pressure on the solubility of naphthalene in water and aqueous tetraalkylammonium salt solutions. Review of Physical Chemistry of Japan 1975(1):615-618.

005007084 Swan, T.H.; Mack, E., Jr. (1925) Vapor pressures of organic crystals by an effusion method. Journal of the American Chemical Society 47:2112-2116.

005007454 Swientoslawski, W. (1917) On the standard unit in the thermochemistry of organic compounds. Journal of the American Chemical Society 39:2595-2600.

005007288 Swietoslawski, W., inventor; Koppers Co., assignee (1952) Method of purifying naphthalene by crystallization. U.S. patent 2,615,058. Oct 21. 3 p. Cl. 260-674.

005015493 Syrkin, J.; Diatkina, M. (1941) The structure of the naphthalene molecule. Acta Physicochimica U.R.S.S. XIV(1):105-118.

005006994 Szent-Gyorgyi, A.; Isenberg, I.; Baird, S.L., Jr. (1960) On the electron donating properties of carcinogens. Proceedings of the National Academy of Sciences 46:1444-1449.

005009258 Szuba, J. (1958) Wplyw dodatku odciekowego oleju naftalenowego na wydajnosc fenoli i naftalenu w procesie ciqglej destylacji smoly. [The effect of drained naphthalene oil on the yield of phenol and naphthalene obtained in the continuous distillation of tar.] Prace Instytutow Hutniczych. [Transactions of the Institutes of Metallurgy.] 10:299-302.

005004734 Tarbell, D.S.; Huang, T. (1959) Use of tetracyanoethylene as a color-forming reagent in paper chromatography of aromatic compounds. Journal of Organic Chemistry 24:887-888.

005010940 Tatem, H.E.; Cox, B.A.; Anderson, J.W. (1978) The toxicity of oils and petroleum hydrocarbons to estuarine crustaceans. Estuarine and Coastal Marine Science 6(4):365-373.

005005907 Tattersfield, F. (1928) The decomposition of naphthalene in the soil and the effet upon its insecticidal action. Annuals of Applied Biology XV(1):57-80.

005005756 Tatterson, B.F., inventor; Koppers Co., assignee (1953) Purification of naphthalene. U.S. patent 2.626.236. Jan 20. 2 p. Cl. 202-57.

005009743 Taylor, C.J.S.O.; Russell, H. (1932) Blackwater fever and naphthalene poisoning. West African Medical Journal 5:48-49.

005016329 Tenney, H.M. (1956) The use of infrared spectroscopy in the study of polynuclear hydrocarbons. Preprints, Division of Petroleum Chemistry, American Chemical Society 1(4):111-116.

005005644 Tesarik, K.; Frycka, J.; Ghyczy, S. (1978) Gas chromatographic separation of naphthalene and biphenyl homologues on capillary columns. Journal of Chromatography 148(1):223-228.

005011847 Thomas, L.H. (1959) An additive function of entropy of boiling, and the prediction of latent heat of vaporisation and vapour pressure of liquids. Journal of the Chemical Society of London 1959:2132-2152.

005010499 Thompson, G.H., inventor; Coal Tar Research Association, assignee (1964) Improvements relating to the production of naphthalene. British patent specification 949,999. Feb 19. 2 p. Int. Cl. C 07c.

005016327 Tin'yanova, N.Z.; Kvasnikov, E.I. (1973) Okyslennya naftalinu ta salitsylovoyi kysloty bakteriyamy rody *Pseudomonas.

005006977 Todd, J.D.; Owens, J.C., inventors; Sherwin-Williams Co., assignee (1935) Purification of naphthalene. U.S. patent 1,996,262. Apr 2. 3 p. Cl. 260-168.

005007425 Trachman, H.; Zucker, F. (1964) Quantitative determination of maleic anhydride, benzoic acid, naphthalene, and 1,4-naphthoquinone in phthalic anhydride by gas liquid chromatography. Analytical Chemistry 36(2):269-271.

005007237 Travis, G.E. (1943) Naphthalene paste. Journal of Economic Entomology 36(3):477-478.

005005210 Treccani, V.; Walker, N.; Wiltshire, G.H. (1954) The metabolism of naphthalene by soil bacteria. Journal of General Microbiology 11:341-348.

005007423 Tunnicliff, D.D.; Rasmussen, R.S.; Morse, M.L. (1949) Correction for interfering absorption in spectrophotometric analyses: application to determination of C6, hydrocarbons and to determination of naphthalene by ultraviolet absorption. Analytical Chemistry 21(8):895-900.

005005413 Uchman, W.; Jennings, W.G. (1977) Effect of heating time on volatile composition of canned pork meat. Food Chemistry 2(2):135-144.

005012756 Ushakova, V.P.; Korneichuk, G.P.; Skorbilina, T.G. (1966) Khromatograficheskoe opredelenie naftalina i produktov ego kataliticheskogo okisleniya. [The chromatographic determination of naphthalene in products from its catalytic oxidation.] Zavodskaya Laboratoriya. [Industrial Laboratory.] XXXII(7):810.

005014806 Ushakova, V.P.; Korneychuk, G.P.; Skorbilina, T.G. (1966) Primeneniye gazozhidkostnoy khromatografii dlya kolichestvennogo analiza naftalina i produktov yego kataliticheskogo okisleniya. [Gas-liquid chromatography utilized for qualitative analysis of naphthalene and the products of its catalytic oxidation.] Khimicheskaya Promyshlennost Ukrainy. [Chemical Industry of the Ukraine.] (4):42-45.

005011505 Vaisberg, K.M.; Kruglov, E.A.; Khabibullin, M.F.; Shabalin, I.I. (1963) Issledovanie sostava razlichnykh sortov naftaline metodom gazo-zhidkostnoi khromatografii. [Gas-liquid chromatography of different grades of naphthalene.] Koks i Khimiya. [Coke and Chemistry.] (3):44-47.

005011537 Vaisberg, K.M.; Shabalin, I.I.; Kruglov, Z.A.; Shmeleva, M.A.; Petrova, L.P. (1965) Kolichestvennyi analiz naftalinovych uglevodorodov C*10 molekulyarnoi spektroskopii. [Quantitative analysis of C*10 and molecular spectroscopy.] Khimiya i Tekhnologiya Topliv i Masel. [Chemistry and Technology of Fuels and Oils.] 10(9):53-57.

005010168 Valaes, T.; Doxiadis, S.A.; Fessas, P. (1963) Acute hemolysis due to naphthalene inhalation. Journal of Pediatrics 63(5):904-915.

005017421 Van Heyningen, R.; Pirie, A. (1967) The metabolism of naphthalene and its toxic effect on the eye. Biochemical Journal 102:842-852.

005007079 Varsanyi, G. (1958) Analytical use of the ultraviolet absorption spectra of saturated vapour mixtures. Acta Chimica Academiae Scientiarum Hungaricae 14:397-406.

005012042 Verkade, P.E.; Coops, J. (1925) Einige Bemerkungen anlaesslich einer Abhandlung der Herren Jaeger und v. Steinwehr "Ueber die Festsetzung der Verbrennungswaerme von Normalsubstanzen".

005009271 Volgina, I.V.; Kostyuk, V.A.; Grigor'ev, S.M.; Markus, G.A. (1975) Extractive refining of pressed naphthalene with sulphuric acid. Coke and Chemistry USSR. A translation of: Koks i Khimiya (11):18-21.

005006224 Wait, S.C., Jr.; Shaffer, F.E. (1963) Infrared spectrum of naphthalene vapor [letter]. Journal of Molecular Spectroscopy 10:78-79.

005006868 Walker, J.Q.; Ahlberg, D.L. (1963) Quantitative analysis of aromatic hydrocarbons by capillary gas chromatography. Analytical Chemistry 35(13):2022-2027.

005005911 Walker, N.; Wiltshire, G.H (1953) The breakdown of naphthalene by a soil bacterium. Journal of General Microbiology 8:273-276.

005007373 Ward, H.L. (1934) The latent heat of fusion and ideal solubility of naphthalene. Journal of Physical Chemistry 38:761-769.

005006653 Watkins, C.H., inventor; Universal Oil Products Co., assignee (1956) Method for producing and recovering aromatic hydrocarbons. U.S. patent 2,766,308. Oct 9. 5 p. Cl. 260-673.

005006042 Wegner, E.H., inventor; Phillips Petroleum Co., assignee (1973) Microbial conversion of naphthalene base hydrocarbons. U.S. patent 3,755,080. Aug 28. 4 p. Int Cl. C 12d 1/00; U.S. Cl. 195/28 R, 195/51 R.

005006110 Wells, P.R. (1963) Proton magnetic resonance spectra of dinitronaphthalenes. Journal of the Chemical Society 1963:1967-1974.

005007302 White, C.E. (1970) Fluorometric analysis. Analytical Chemistry 42(5):57-76.

005010389 Wiedemann, O., inventor; Chemische Fabrik von Heyden A.G., assignee (1963) Verfahren zur Gewinnung eines Naphthalinluftgemisches. [Method to produce a naphthalene-air mixture.] German (Fed. Rep.) auslegeschrift 1,149,346. May 30. 2 p. Int. Cl. C 07c.

005006659 Wilcock, D.F., inventor; Sherwin-Williams Co., assignee (1943) Purification of naphthalene. U.S. patent 2,321,117. Jun 8. 6 p. Cl. 260-674.

005011109 Wilhelm, R.M.; Finkelstein, J.L. (1919) A standardized method for the determination of solidification points, especially of naphthalene and paraffin. Scientific Papers of the Bureau of Standards (U.S.) 15:185-197.

005011275 Wilk, M.; Rochlitz, J.; Bende, H. (1966) Saeulenchromatographie von polycyclischen aromatischen Kohlenwasserstoffen an lipophilem Sephadex LH-20. [Column chromatography of polycyclic aromatic hydrocarbons using lipophilic Sephadex LH-20.] Journal of Chromatography 24(2):414-416.

005010789 Williams, P.A.; Catterall, F.A. (1968) A possible spectrophotometric assay for a bacterial naphthalene oxygenase. Hoppe-Seyler's Zeitschrift fuer Physiologische Chemie 349(11):1633-1636.

005005610 Williams, P.A.; Catterall, F.A.; Murray, K. (1975) Metabolism of naphthalene, 2-methylnaphthalene, salicylate, and benzoate by Pseudomonas P G: Journal of Bacteriology 124(2):679-685.

005006108 Wilshire, J.F.K. (1962) The pyrolysis of 1-phenyltetralin. Australian Journal of Chemistry 15:538-547.

005005609 Wodzinski, R.S.; Bertolini, D. (1972) Physical state in which naphthalene and bibenzyl are utilized by bacteria. Applied Microbiology 23(6):1077-1081.

005015481 Wodzinski, R.S.; Johnson, M.J. (1968) Yields of bacterial cells from hydrocarbons. Applied Microbiology 16(12):1886-1891.

005005608 Wodzinski, R.S.; Larocca, D. (1977) Bacterial growth kinetics on diphenylmethane and naphthalene-heptamethylnonane mixtures. Applied and Environmental Microbiology 33(3):660-665.

005006127 Yaws, C.L.; Turnbough, A.C. (1975) Benzene and naphthalene. Chemical Engineering 82(18):107-115.

005005236 Zinkham, W.H.; Childs, B. (1958) A defect of glutathione metabolism in erythrocytes from patients with a naphthalene-induced hemolytic anemia. Pediatrics 22(3):461-471.

005006217 Zipp, A.; Kauzmann, W. (1973) Anomalous effect of pressure on spectral solvent shifts in water and perfluoro n-hexane. Journal of Chemical Physics 59(8):4215-4224.

005011315 Zueger, E. (1967) Die Gewinnung von Naphthalin aus dem Steinkohlenteer. [Extraction of naphthalene from coal tar.] Chimia 21(7):336-338.

OFFICE OF PESTICIDE PROGRAMS
Registration Standard Bibliography
Case GS0022 Naphthalene
Section 3
Standard Reference Material Used in Support of this Standard

MRID	Citation
GS0022037	Benefits and Field Studies Division, September, 1979. Pesticide Chemical Use Pattern Profile for Naphthalene. USEPA Office of Pesticide Programs.
GS00220036	Scarato, R. (1980) Preliminary Quantitative Usage Analyses of Coumaphos. Economic Analysis Branch, Benefits and Field Studies Division, Office of Pesticide Programs, U.S. Environmental Protection Agency.
GS0022035	Stecher, P.G.,ed. (1968) the Merck Index: An Encyclopedia of Chemicals and Drugs, Eigth Edition. Merck and Company, Rahway, N.J.
050193616	U.S. Environmental Protection Agency, Office of Water Planning and Standards (1978) Naphthalene: Ambient Water Quality Criteria, Washington, D.C.: U.S. Environmental Protection Agency, Office of Water Planning and Standards. (Available from; NTIS, Springfield, VA; PB-296 786).

*U.S. GOVERNMENT PRINTING OFFICE: 1981--361-082/267